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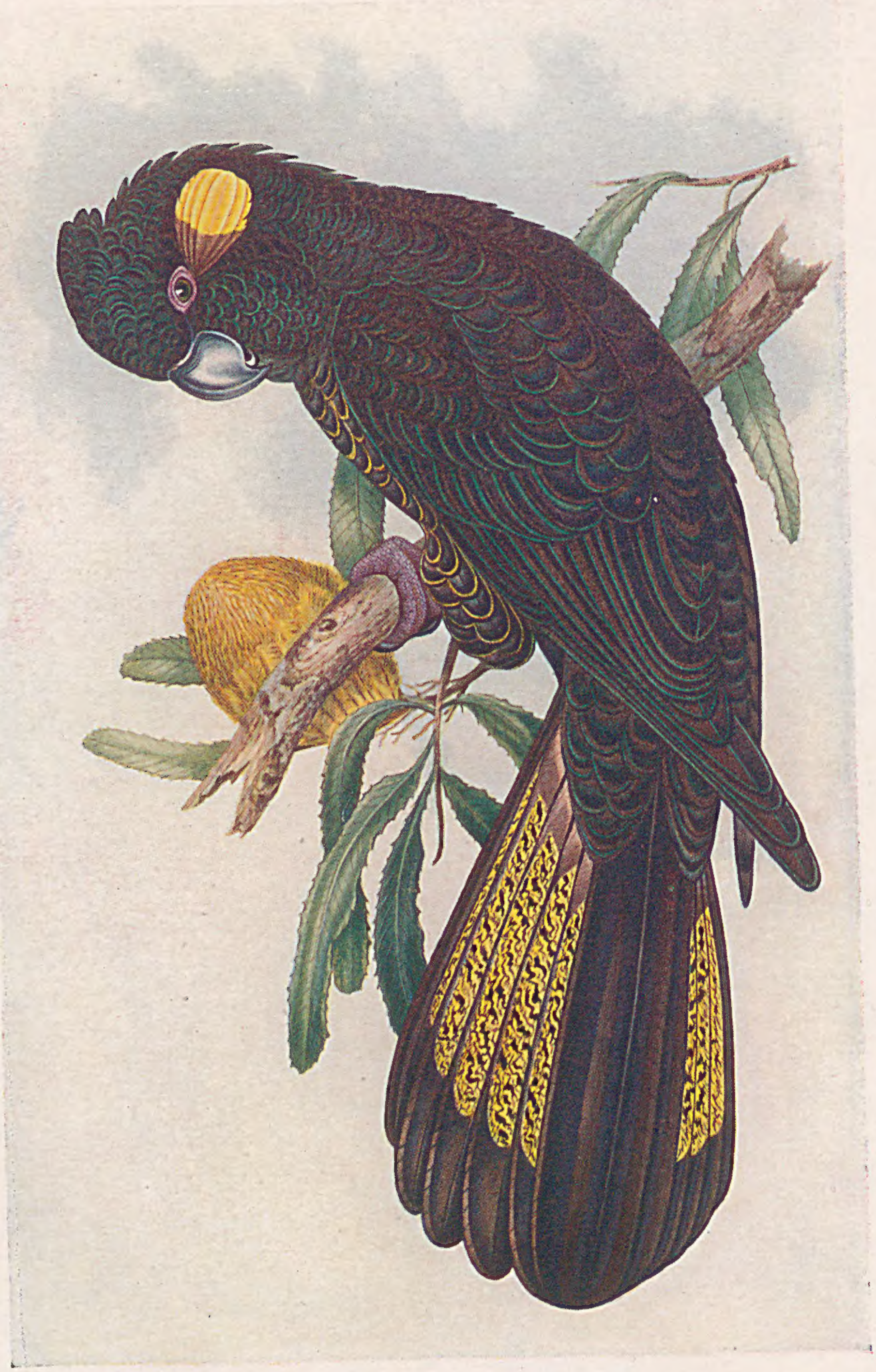

" FOREST GUARDIAN,"

Black Cockatoo—*Calyptorhynchus funereus*, Shaw.

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FOREST INSECTS

AND

TIMBER BORERS

BY

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FOREST ENTOMOLOGIST

Author of

"Australian Insects." "The Sheep Maggot Fly in Australia."
"Some Useful Australian Birds." "Forest Insects of Australia."
"Insect and Fungus Diseases of the Coconut."

With a Coloured Frontispiece, and 30 Original Plates of their life histories drawn by

MISS E. A. KING.

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INTRODUCTION.

The following pages, most of which have appeared in *The Australian Forestry Journal,* illustrate the work upon which I have been engaged during the last three years while special forest entomologist to the Commission. Soon after my retirement from the position of Government Entomologist to the Department of Agriculture, an unofficial committee was formed by the various associations interested in the timber and building trades, to which I was invited to attend. We had a number of meetings to consider the increase of timber pests and the best methods to be adopted to check their ravages, and to prevent the importation of foreign species. As an outcome of the deliberations of this committee, the then Minister of Lands and Forests (Hon. W. E. Wearne), who himself took a keen interest in these matters, received a deputation, at which most of the associations were represented.

At this meeting he promised to have investigations carried out, and shortly afterwards the Cabinet, at his request, appointed me for the term of a year as special forest entomologist to carry out investigations dealing with these matters. This appointment was renewed for another year, and was in force when Mr. Wearne retired from office. When it elapsed the Hon. P. F. Loughlin, who also took a keen personal interest in the timber and forests of Australia, had it again renewed till the end of last year. At the united request of Mr. N. W. Jolly, Commissioner of Forests, and the Hon. W. F. Dunn, Acting Minister of Lands and Forests, the Premier, the Hon. John Lang, agreed to my appointment being extended to the 31st March, 1927.

During my tenure of office I have visited many town and country saw-mills, and examined large numbers of logs and shipments of sawn timber, chiefly from the East and the Pacific Islands. I have travelled through many of our large forest reserves, and have collected and examined all kinds of timber and other forest insects. Large numbers of borers have been cut out of felled trees and seasoning timber, many collected in the earlier stages of their development and their habits studied in the Forestry Insectarium; all have been examined, identified, classified, and placed in the cabinets.

All specimens doubtfully named or unknown to me have been submitted to the leading authorities on timber insects. Mr. Paul Lesne, of Paris, has identified the *Bostrychidæ* and *Lyctidæ*; Lieut.-Colonel F. Winn Sampson, of London, has examined the *Scolytidæ*. Others have been named by Mr. A. M. Lea, of Adelaide. During the last three years I have had an intensely interesting time, and have met with unfailing courtesy from the members of the timber trade and from all the officers, both in the field and office staff, of the Forestry Commission. It is through the great assistance given me by them that I have been able to gather together in so short a space of time much of the information included in this Bulletin. I would particularly like to mention the practical assistance given by my friend Mr. W. L. Wearne, who has interested himself for some years in the most up-to-date methods of destroying borers in timber; he has not only placed his practical knowledge at my disposal, but has roused an interest among the saw-millers and timber merchants in the value of protective measures. I would also thank Mr. C. F. Davies, of the Brooklana Timber Company, for the assistance given in carrying out our experiments in the Dorrigo forest on the treatment of timber to protect the timber against Powder-post *Lyctus* beetle infestation while seasoning at the saw-mills.

My first-hand experience of treating timber enables me to state that at a very reasonable cost all our valuable forest timbers can, after they have been cut up on the saw bench, be protected during the period of seasoning from Powder-post beetles, after which they are immune from infestation. These beetles strictly confine their attention to the sapwood of the timber, but in many of the logs there is so much sapwood that it would not pay the saw-millers to mill the log and cut out the outer portion. In most trees this outer portion of the log comprises sound timber as useful and enduring as the harder heart wood, which is only rejected at the present time because of its liability to be infested before being made up into furniture or buildings by the larvæ of these beetles.

There are many thousands of pounds worth of fine timber annually destroyed by another very distinct family of small timber borers. These are logs which when delayed in transit from the forests to the saw-mills remain where they have been felled or assembled on the river bank for shipment, and become infested with tiny "pin-hole" borers. These beetles and their larvæ remain feeding and multiplying, and cut their way right through the heart wood, working in the log as long as it contains any moisture. This infestation takes place in our coastal forests, but is most serious in the forests of the Pacific Islands and the East, timber companies frequently sending shipments of logs to Sydney saw-millers which, when cut up, consist of nothing but "pin-holed" second-rate timber, for which they have to take anything they are offered.

Considering the value of these logs when delivered in a sound condition at the saw-mill, it would certainly pay the owners to spray or paint these logs as soon as they are felled in the forest, barked or unbarked, with an adhesive repellant mixture of creosote, tar, and oil, which will keep all pin-hole borers away. Some of the up-to-date merchants both here and in Borneo and the Philippines are using these protective methods with marked results.

The study of forest entomology includes many interesting and important problems before the trees become commercial timber. With the replanting of forests all over the world, and the regeneration of our forests, we are sure to have an increase of forest pests. While we have many indigenous insects peculiar to our forest trees, we are also always in danger of introducing foreign pests, which, free from the natural parasites which keep them in bounds in their native land, are nearly always more destructive than indigenous insects.

Among our own recognised pests may be mentioned the various species of Bag or Case moths, stripping all the foliage off trees in avenues and plantations; the Cedar tip moth, which has virtually stopped the development of cedar plantation both here and in Queensland; the Lace Lerp, which defoliates the ironbark saplings over a large area of our northern forests; and moth and beetle larvæ which remain for several years developing from grub to perfect moth or beetle in the roots or trunks of growing trees.

I think that the series of articles included in this Bulletin will convince anyone of the necessity of having a forest entomologist (who can devote the whole of his time to the work) attached to every Forestry Department in the Australian Commonwealth.

There should be plenty of young men in Australia who, with a little training, could take up this important and interesting work. One with a general knowledge of the conditions under which our forest trees grow, and also of the type of men working in the forests with whom he comes in contact, would have a great advantage over the theoretical student fresh from college. A working knowledge of the botanical and popular names of the forest trees and shrubs would help him very much in his study of forest entomology. Also he should be a man not afraid of roughing it when doing field work in the forest, for a forest entomologist does much of his collecting with an axe, not a butterfly net.

FOREST ZOOLOGY.

A WELL-KNOWN writer has said, "If it had not been for man, the whole world would be ruled to-day by the forest."

Richard Jeffries, the nature-study writer of England, in his remarkable book, "After London, or Wild England," tries to visualise what would happen if London and the civilization of to-day vanished. He graphically outlines how the whole of England rapidly reverted to the dense forests and thickets of prehistoric times.

In modern times it is hard to realise that two thousand years ago the whole of Great Britain and Europe was one unbroken forest, stretching across from the Baltic to the Mediterranean Sea. In its shelter the ancestors of the present nations of Europe dwelt, and hunted for their food, developing through the ages to the present standard of civilization.

The forest not only tinged all the life, but even the religion of the different tribes. In the dense sombre pine forests of the north, where life was one long struggle with the elements, the inhabitants peopled them with stern all-powerful gods—Thor, Odin, Woden. In Southern Europe the open glades of the oak and elm forests of Greece and Italy were given over to wood nymphs, fairies, and dryads. Both the stern old gods of the north and the merry goddesses and gods of the south have vanished for ever. In Australia, few of our most imaginative forest dwellers found time for more than a description of an echo down a gorge. There is hardly a record of any bird or animal which sheltered in our virgin forests when the cedar-getters opened up the Northern Rivers.

No one thought of saving even a few acres on any of the river bends, for a forest park, or for a national reserve. Perhaps the most notable exception is the patch of virgin bush on the Manning River at Wingham, due to the exertions of the late W. Allan. It remains a nature monument to his memory. Our Australian forests are full of wonderful creatures. Of these only the nature-lover and the naturalist know the infinite number and variety. They find food and shelter within and upon our forest trees. Whenever a tree is cut down and destroyed innumerable little creatures are homeless. When whole forest areas are cleared and burnt down, without even a single shade tree left in the paddock, a world of little lives is banished. The birds fly away, and the forest animals are killed.

A very large number of Australian animals are nocturnal in their habits. Opossums, sugar squirrels, bandicoots, wombats, native bears, and the smaller rodents hide in the wood and feed at night. Even the larger kangaroos do much of their grazing in the cool of the evening.

Having realised this, one can understand what an important part forest cover plays in the protection of our indigenous animal life. Every hollow limb of a tree, every cavity in the trunk, has a resident lodger.

It is inevitable that, as civilization advances, forests must be cut down and cleared away to make homes and profitable holdings on which to grow food. It is usually the richest land which grows the densest forests; but there is also much forest land which is neither suitable for growing crops, or even for grass when ringbarked.

It is want of knowledge of these conditions that has led to the clearing of mountain ranges, and of plateaux which, like the whole of the Dorrigo Plateau, should have been strictly defined as national forests for all time.

Before there was a Forestry Department the Lands Department had a free hand to deal with public lands. When Forestry Commissions were created in the different States, much initial damage had been done, and much poor land alienated. Until recent years there has been a tug-of-war between the two Departments, Forestry asking for the dedication of forest areas for the State; the land-seekers constantly urging the resumption of such land for settlement; and it certainly did not add to the popularity of the Lands Department to refuse the applications.

All credit is due to the officers of the Lands Department for the large number of reserves and sanctuaries for flora and fauna which have been withdrawn from sale or selection. In a list furnished to me by the Lands Department there are 105 reserves in New South Wales for the preservation of native flora alone.

These reserves vary from 3,000 to 16,000 acres in extent. A list of many large areas, which covers over two pages of the *Government Gazette,* issued 7th January, 1927, defines the districts as sanctuaries, where no shooting is allowed, and where animals and birds are protected all the year round. All State forests covering another large area are proclaimed sanctuaries, and the forest officers have authority to deal with trespassers. So that we now have some hope of preserving both our flora and fauna under the present enlightened administration.

In considering the animal life of our forests we must go back to very early days, when kangaroos grazed over the flats of Petersham, and were hunted at Long Nose Point, when they incautiously entered that narrow neck of land in a suburb of Sydney.

When domestic animals and foreign plants came into competition with our indigenous fauna and flora, pests of both animals and plants developed from introduced species of both. Prior to the advent of man, our animals and plants had grown up together in the forest, side by side, throughout the ages; they adapted their lives to each other, and developed resistant qualities to the varied climatic conditions of Australia.

When, however, by the alteration of the balance of power, usually the removal of some natural check, there was an abnormal increase of any particular species of plant or animal, something suffered. Some animals' food plants were in danger of extinction; on the other hand the plants overgrew themselves, became thickets of stunted saplings which, attacked by insect and fungus pests, died when drought conditions prevailed. But where man or his foreign plants and animals did not intrude, nature always reasserted herself, and normal conditions returned.

We have three dominant plant pests that have made serious inroads to our forest lands. First and foremost, the prickly-pear (Opuntia); second, the lantana; thirdly, the blackberry, with its trailing thorny canes.

We have in Australia a remarkable uniformity in our great land areas. Over the greater part of the continent, the dominant forest flora consists of trees belonging to the two great botanical genera, *Eucalyptus* and *Acacia,* popularly known as "Gum tree" and "Wattle." Botanists have classified over 200 species of eucalypts, and over 500 species of acacia, scattered over the whole of Australia.

At the same time we can roughly divide our forests into three distinct types, though in places they overlap each to a certain extent. Within these types are to be found birds and animals peculiar to each.

The first division, and most important from a commercial standpoint, is the hardwoods forests. These almost encircle Australia, and extend inland for a considerable distance in many parts of the continent. These myrtaceous trees, which vary in form from the stunted mallee scrub gums of the interior to the giant blackbutt of the Gippsland forests of Victoria, comprise the commercial hardwoods. They are known under many popular names; the jarrah and the karri of South-west Australia, messmate, tallow-wood, spotted gum, red gum, ironbark, blackbutt of the eastern coast, blue gum of Tasmania and Victoria.

This type may be described as forest, with or without undergrowth, and sometimes with little undergrowth, often containing park-like lands, lightly clothed with grass and small shrubs, the home of kangaroos and other grass-feeding animals. The second type of forest, though limited in extent in New South Wales, spreads out into more tropical coastal valleys and mountain ranges of Queensland. These forests are known as "cedar brushes," because red cedar was the chief timber cut out by the pioneer timber-getters. They have also been called "rain forests" in Australia and the Malayan Islands. Besides cedar, most of which was cut out forty years ago, they contain many fine timber trees, among them Queensland maple, crab apple, red beech, sassafras, silky oak, suitable for furniture and interior decoration. Allied to these are the "plateau forests"; such is the Dorrigo scrub which is the natural home of the hoop pine, and is interspersed with the forest trees previously enumerated.

The third type is the "western scrub forests," west of the coastal ranges. It may be said to spread over the dry wilderness lands of Central Australia. The great "Pilliga Scrub" comprises about 3,000,000 acres of open forests; cypress pine, casuarina, ironbark, and a host of small scrub trees. It is a fine example of the dry land forest, of which the cypress pines are the most numerous and the most valuable timber trees.

As eucalyptus and acacia are the dominant trees in our forest flora, kangaroos, wallabies, opossums, and native bears take first place in the forest fauna. These, particularly kangaroos, have played an important part through the ages, in the growth and development of the forest. They should be encouraged now to play a more important part in protecting our young forests.

The greatest enemy of forests, the nightmare of forest officers all over the world, is fire. Thus, one of the chief difficulties in reafforestation is to keep down the grass without injury to the smaller trees. If grazing permits are allowed, and sheep, horses, and cattle are depastured in any forest, the seeding and young trees suffer. In some of the large red gum forests on the Murray River, where sheep are constantly grazing, there is hardly a seedling or young trees to acres. They bite off the tops of the young trees, and in a bad year they eat them down to the ground.

Cattle are nearly as bad. They not only eat down all the soft foliage trees, but break down the young saplings; they are exterminating some of the rare trees. In many of the western scrubs, the beautiful, graceful quandong (*Fusanus acuminatus*), with its silvery foliage and bright red fruits, was quite a common shrub on the sandhills before cattle were turned out. Cattle are particularly fond of it, breaking it down and eating foliage and branchlets. Last season, when dry conditions reigned for months over the Northern Rivers, horses and cattle ate down all the young red cedar trees growing on the edge of the forest. To comprehend how the grazing of sheep will affect our western scrub lands, one need only fence in a small area round his homestead or horse paddock, and watch how rapidly it is clothed with young seedlings of the boree or weeping myall (*Acacia pendula*), and other characteristic plants non existent outside the fence in the sheep run.

The Kangaroo.

The kangaroo is the natural guardian of the forest. He is not a herbiferous animal. The structure of the teeth of the kangaroo is remarkable. The two front teeth, loose and shaped like scissors blades, show how they are real grass-cutters; so that he cannot to any great extent feed, if he wanted to, upon the foliage of trees.

Now, all our State forests are sanctuaries. With very little extra protection the various species of kangaroos and other small marsupials would soon breed in sufficient numbers to eat down all the rank grass in the forest lands.

The danger from fire would be greatly reduced, without any damage to the growth of the forest. When the kangaroos had outgrown their food supplies on the living areas, it would be a very simple matter for the forest rangers to have a round-up, and kill off the surplus animals. At the present price of kangaroo skins the utilization of the open forest as kangaroo ranges would be a very profitable investment. While improving the forest areas they would bring in more money to the Commission than the sale of grazing permits to the adjoining land-owner.

The Opossum.

Under normal conditions, opossums are found in all our hardwood forests. It is only a matter of adequate protection from illegal shooting, that would rapidly increase their numbers. Under favourable conditions opossums breed very quickly. With the wholesale destruction of iguanas or monitor lizards, on account of their fondness for poisoned rabbits, combined with the extermination of hawks and eagles, through settlement, all serious enemies of the opossum, they are living now under improved conditions.

They feed almost exclusively upon the foliage of different species of eucalypts; and we have large areas in which the opossum could be profitably farmed and protected, there is no difficulty in breeding opossums. When taken to New Zealand some years ago and liberated in the forests, they multiplied so rapidly that the trees were defoliated before the damage was traced to the opossums. Their protection was removed, and the surplus caught and skinned. More recently, numbers were turned out in the great nature reservation at Wilson's Promontory in South Victoria. Here enemies were also non-existent. Since then they have increased in such numbers as to strip large areas of foliage.

During the last twenty-six years millions of opossum skins have been exported to Europe and America, and their market value is rising every year. There should be a steady revenue from protected opossums, even if special officers had to be appointed to police the forest areas.

The Native Bear.

There was a time when the native bear, one of the most helpless and harmless animals in Australia, was common all over the big gum forests, from Gippsland, Victoria, to South Queensland. About twenty-five years ago some obscure disease spread along our coast; and native bears died in hundreds and fell from the trees. The ring-barking of large areas of the forest also destroyed their supplies (gumleaves), and they wandered into adjacent gardens and orchards. Here they were killed in scores. Later considerable numbers were found in South Queensland. People leased Crown land areas simply to get the right to shoot native bears for their tough, thick skins, and short fur, which was sought after in the American fur market.

There is no reason why the native bear should not be able to hold its own, and to increase in numbers, if properly protected in suitable gum forests.

The Wombat.

I have some diffidence in introducing the wombat to the favourable notice of the forestry officers. A harmless hard-working Australian, he digs deep burrows into the hard soil, looks after his wife and family, and usually lives in rough, rugged country. He has one vice, which causes him to be treated as an outlaw with a lawful bonus on his head, though his skin is of little marketable value. He is a thick-set bull-headed creature who sternly objects to wire-netting. His habits are nocturnal; and living underground he is not often seen by the ordinary traveller. When in his nocturnal rambles he comes up against a wire-netted boundary fence of a forest plantation, he does not go round, but sets to work and, with his powerful jaws and stout legs, tears a hole through it and continues his ramble. The holes are soon discovered by the rabbits and hares, and a great deal of damage to the young trees may be done before the forest officer locates and mends the hole.

Flying Squirrels.

There are many flying squirrels and sugar squirrels hidden in the hollow spouts on the dead limbs of the forest trees, but they are seldom seen unless one is camping at night in the forest. Many small rodents, rats and mice, roam through the bush at night, sleeping through the day under the roots of the trees or coiled up under hollow logs. That quaintest of Australian animals, the ant-eater, is busy through the night digging into ants' nest for his supper, his curious grunt when alarmed, one of the most distinctive voices of the night.

The Rabbit.

European rabbits were included in the list of live-stock which arrived in the colony of New South Wales with the first fleet, and there were many subsequent importations. They were even turned out in 1851 on the Upper Murray. None of those early immigrants appear to have gained a footing in Australia. It was from other importations into South Australia and South-west Victoria that the rabbits bred up. In the early eighties they started their exodus northward, crossed the Murray, and spread all over New South Wales.

Besides being a very serious pest to the pastoralists and farmers, they do a considerable amount of harm to forest areas. They eat the young seedlings and small shrubs when grass is scarce, and gnaw the bark off trees. In the mallee scrub country of North-west Victoria in the early eighties they were most effective ring-barkers. Standing on their hind legs they stripped the bark of thousands of mallee gums as far as they could reach up the stems. The presence of rabbits in the vicinity of any forest plantation necessitates enclosing the area with wire-netting.

The Hare.

Though never very numerous, and usually living more in agricultural areas, the hare, another introduced animal, often takes up its residence on the edge of the forest. If they find their way into a forest plantation they have the bad habit of nipping off the tops of the young trees, and nibbling off the bark, which they seem to take as a tonic. In this manner a solitary hare often does a great deal of damage before it is discovered.

Birds.

The birds of the forest have been dealt with in my previous book, "The Forest Insects of Australia," but all students of forestry know the important part that many of them play in distributing the seeds of the trees through the forest. Others deal with wood borers and defoliating insects.

In traversing the forest where timber-getters are cutting the marketable trees one naturally finds a large increase of timber-boring insects, on account of the amount of dead and decaying wood strewn over the floor of the forest.

Some insects attack the logs as soon as they are cut up in the forest, and also dead logs abandoned because of faults or internal damage, which renders them valueless for the sawmiller.

The heads and stumps of the felled trees soon become riddled with grubs or larvæ of all kinds of insects. Some confine their attention to the bark. Many feed between the bark and the sapwood, and others continue working their way right through the heartwood as long as there is any moisture left in the log. In tropical forests the most important problem for the timber company, particularly if exporting the timber in the log, is to protect these logs from the swarms of tiny pin-hole borers (Xyleborus). This borer is always on the move in these forests. Thousands of pounds are lost annually through such logs being "pin-holed" before they reach the sawmill. The only way of overcoming the difficulty is by coating such logs; by spraying or painting them with some repellent adhesive mixture as soon as possible after they are felled and cut up in the forest.

The increase of insects in the forest areas will mean more food supplies for our native birds, so that the value of making every forest a sanctuary where the birds are not molested is a wise move on the part of the Forestry Commission.

THE BLACK COCKATOO.

(*Calyptorhynchus funereus*, Shaw.)

The Australian forests with their varied flora give food and shelter to some of our most beautiful birds, from the tiny honey eaters, to the great wedge-tailed eagle.

As is always the case, these birds are adapted in structure for the life they lead. Most of our eucalypts, banksias, and such smaller shrubs are rich in nectar; and those birds which live on the honey of the flowers, have the slender beak and the delicate feather-tipped tongue so well illustrated in the dainty little "cobbler's awl." This bird is not an uncommon visitant to our suburban gardens. The ground-feeders, such as the brush turkey, have powerful scratching feet and a solid bill for destroying hard-backed beetles, and for smashing the shells of the land shells.

Among the most characteristic which cannot live away from the forest lands, is the black cockatoo, with its dark somber plumage, and its harsh whining screech. At one time this bird was very plentiful, and was widely distributed throughout our big tree forest along the eastern coast, and even extending far inland in suitable areas. The writer remembers a large flock in the sandstone gorges at the head of the Flinders River, Central Queensland. It came to feast on the flowers and the hard seed capsules of a yellow flowering eucalypt. In the early days of settlement, a writer describes how he disturbed a large flock on a drive from Sydney along the Old South Head road.

Broadly speaking, they are never very numerous, and do not congregate in large flocks, as do the sulphur-crested white cockatoos and galahs.

Black cockatoos are peculiar to Australia, New Guinea, and the Malay region. There are five species described from Australia. Three of these are found in New South Wales.

The Yellow-eared Black Cockatoo (*Calyptorrhynchus funerius*, Shaw) is the commonest species, ranging from Tasmania to Queensland. Its feeding habits may be considered omniverous. It eats seeds, cutting up seed cones such as the calyx of the flowering gums. It cuts out and devours the many wood-boring larvæ of beetles and moths, which otherwise would do so much damage in our forests. In our hardwood (eucalyptus) forests, in the cedar brushes, and in the open wattle scrubs, there is a remarkable beetle and moth fauna. The larvæ of these beetles and moths feed in burrows they make on the living trees; and their infestations are responsible for the stunted growth or the death of hundreds of otherwise healthy trees.

When once the larvæ of these forest insects emerge from their eggs deposited on the bark, their object in life is to cut their way through the bark, and to gain the shelter of the sapwood. A very large percentage never get through the bark. Others are hunted and devoured by predaceous insect larvæ while feeding in the sapwood. Those, however, who escape all these dangers, and get securely entrenched in their chambers in the heart of the tree are secure from such dangers.

The wonderful instinct of the black cockatoo enables it to find a woodborer's home, even right in the heart of a well-grown tree. With its powerful beak it can tear out the wood, or strip off the bark, until it can hook out the fat grub.

It is a well-known fact that most of our coastal wattles are short-lived, because of these timber-boring insect larvæ; and it is probable that the tree's early death is due to the absence of the black cockatoos which, before settlement, policed all such areas.

In 1926, when going through some open ironbark forest near Clarence Town, where there was an undergrowth of black wattle, I found that a very large number of the smaller trees had been infested with the larvæ of longicorn beetles.

Looking for specimens of these larvæ in the stems, I found that the black cockatoo had already been on the same quest.

They had neatly torn out the sides of the stems and had devoured the grubs some weeks previously.

In several of the spotted gum forests near Taree I found well-grown trees up to 2 feet in diameter, where the bark had been heavily infested with the larvæ of the Australian Goat Moth (*Culama rubiginosa*). An area several feet from the ground as large as a dinner plate had been picked off the sapwood. Every fat red grub had been eaten; the rejected bark formed a neat pile on the ground beneath.

I have never been able to find any person who has seen the black cockatoo engaged at this work; and it would be very interesting to see and to learn how she supports herself on the smooth white bark of the trunk when cutting out her breakfast. It is quite a common thing on the Blue Mountains to find a well-grown tree with a ragged cavity, several inches deep, torn out of its side. A black cockatoo had obtained a wood moth larvæ thus. On the Bulga Plateau, at the edge of the forest last year I found a natural plantation of grey gums, which had been infested with the larvæ of the green wood moth (*Charaga* sp.). Here, nearly every tree had been investigated by the black cockatoos; and one tree, a foot in diameter, which stood out from the rest, had been cut right through to the centre to obtain the grub.

Later in the year, when driving from Armidale to the Styx River, we passed through a messmate forest previously ringbarked; here the black cockatoos had torn down long streamers of the loosened dead bark when they were hunting out the *Phoracantha* beetle larvæ in the sapwood.

In the *Australian Forest Journal,* August, 1919, a correspondent gives an account of a similar forest at Interlaken, Tasmania, where the black cockatoos had stripped some stringy barks (*Eucalyptus obliqua*) in a similar manner.

As all our proclaimed forests under the supervision of the officers of the Forestry Commission are sanctuaries, it is to be hoped that this valuable forest guardian will not be molested in its native haunts and will increase in numbers.

FOREST ENTOMOLOGY.

An observant forest officer has many opportunities both for collecting specimens of rare insects and for gathering most valuable information concerning their habits. Some of these insects are sure to be of economic importance; and may do great damage to the forest; they may infest the logs after the trees are felled; they may attack the sawn timber whilst cut up and seasoning at the sawmills or in the timber merchants' yards. When an officer's interest is once aroused, it is wonderful how many previously unnoticed and even common everyday objects in the bush will attract his attention. When once the spirit of inquiry comes, a bush naturalist is created. Then the official entomologist has a valued correspondent.

During the writer's connection with the Agricultural Department he had bush naturalist correspondents in all parts of the Commonwealth; and in his varied investigations he recorded very many important notes from out-back residents. He received also numbers of curious insects previously unknown.

The important part of an entomologist's study concerning insects, from an economic point of view, is not merely the detailed description of the perfect insect, but to work out its life history, egg, grub, pupa, and identify each with the perfect insect.

In the study of forest insects, knowledge of their habits, such as their methods of infesting trees, the time of year when trees or timber are most likely to be attractive to them, when they are breeding in, or emerging from, the wood, and the particular species of tree each pest infests, are all points of the greatest importance when the question of reducing the damage they cause is under consideration.

The man in the forest can often obtain the whole life cycle of a timber borer in an infested log or tree stump, where egg, grub, pupa, and perfect beetle of the same species can be found developing side by side. The majority of the most serious pests in the forest can be placed in two groups—beetles, moths. In the first it may be either the perfect beetle or the grub that does the damage: often it is both. Among the moths the damage to the timber is only done by the grubs.

Both beetles and moths undergo a complete metamorphosis; that is, they have four distinct stages of life, sharply marked off from each other. First the egg, then the grub or caterpillar stage, when the main object of life is to eat and grow, and so rapid is its development that its skin becomes too small for its increasing girth; thus at regular intervals the grub has power to burst and cast off its outer hardened skin, exposing a thinner and more elastic one which had formed under the protection of the old one. There are several of these moults especially among the moth caterpillars before the hungry larvae is fully fed.

When the grub or caterpillar has reached its full development it ceases eating and prepares its resting quarters. A wood moth larva entrenched in its burrow in the tree trunk has no need to enclose itself in a silken cocoon. It simply seals up the opening leading to the cavity at the end of the bore, where, resting in this larval chamber, it casts its last worn jacket, which crumpled up, falls like a descarded suit to the bottom of the burrow.

The beetle grub goes through exactly the same process of evolution, but usually does a great deal more boring in the timber, bark, and sapwood before it finally attains full size and pupates.

The insect has now reached the third stage of its existence—the pupa. Enclosed in the new pupal shell, it reveals a delicate coat of fine armour-plate formed of a horny substance called chitin; this is much more protective during its helpless pupal state than the previous larval skin.

In this chitinous shell it cannot eat, and its movements are restricted to a few contractions of its anal segments if disturbed. An insect pupa is a wonderful object—under the delicate, semi-transparent chitin, every organ of the coming moth or beetle is outlined in the tightly-fitting covering—eyes, mouth, antennae, legs, folded-down wings, and body segments. In the case of beetles which transform into the final perfect insect stage, often at a considerable distance from the outer surface of the timber, and may remain there a considerable time before they seek the outer world, no special appliances are required on the larval shell.

It is different, however, in the case of the pupal wood moth; it has to get out of the pupal chamber, and also get out of the closely enveloping armour-plate without injuring its delicate scales and wings. Therefore, it is furnished with a stout thorn or knob in front of the head for pushing out the silken wad or other obstruction at the top of the pupal chamber, or working its way up through the earth if feeding on the roots of the tree. The body segments are also ringed with hard serrate spines; these assist it to work its way, with a rotary motion, up a vertical bore in the tree trunk.

Having sufficiently developed in the pupal case to emerge as an adult insect, it works its way back to the opening in the stem or tree trunk, where it had entered and fed during its hungry caterpillar existence. Arriving there, it forces its cylindrical pupal body through the opening as far as the shoulders. The chitin armour-like skin then splits down the centre of the back, the moth drags the rest of its body out and crawls out into the tree trunk, leaving the empty pupa case sticking out of the hole in the side of the tree. These dark reddish-brown cases are common objects in the forest in summer time; they are even more numerous at times in the more open forest lands, sticking out of the ground when their occupants were root-feeders in their caterpillar state.

The fourth stage is now reached; the perfect adult moth or beetle has emerged, with all its organs of sight, touch, and movement perfected. It is an active creature, able to move about on the tree, or fly from tree to tree, furnished with mouth, jaws, digestive organs, a simple nervous and breathing system, and reproductive organs. The sexes of many insects can be easily distinguished from the outward structure of the antennae, shape of head and body, or relative size.

Though the majority of insects feed in the adult state, their main object in life is to mate and reproduce their species.

The eggs of most beetles are enclosed in a stiff skin and are deposited singly in or upon the surface of the bark or wood.

The eggs of the larger wood moths are remarkable for their small size. They are often hard and round like duck shot, and some moths deposit many thousands of eggs upon the bark of trees.

Nature's laws are stern and exacting. If all these eggs were to develop into hungry grubs, and enter the bark, there would, in a few generations, be no forest trees; but birds, ants, and many carnivorous insects take their toll of eggs and baby grubs; so that hardly 1 per cent. in most cases ever succeed in entering a safe burrow in the tree trunk. Even when they do get there, all through the different stages of their lives predatory beetles and their carnivorous larvae devour them, and ichneumon and chalcid wasp lay their eggs in or upon the naked larvae of the moths.

These wood moths are generally ready to emerge towards the end of the summer. They are then resting at the bottom of the vertical shaft in the centre of the tree trunk. This burrow varies from 6 to 12 inches in depth, and is connected with the clear-cut transverse bore which the grub made after penetrating the bark.

When a forest tree is found to contain one of these moths pupa, it is not difficult, if the trunk is not too thick, to breed out the perfect moth in captivity. The forest officer should, without disturbing the enclosed pupa, cut off the stem a few inches above and 18 inches below the opening. The log should be placed in a box and kept under observation. When the moth emerges it should be allowed to rest until its wings have unfolded and dried, when it can be killed and mounted. The writer would be very glad to receive sections of any moth-infested twigs or branches, which could be sewn up in hessian or rolled up in paper and forwarded to the offices of the Forestry Commission. There the infested timber can be kept and examined at intervals until the perfect insect emerges.

Many of the smaller but very beautiful wood moths infect the smaller saplings, and when they have burrowed out the cavity surround the entrance with a closely-felted silken bag encircling the whole stem. If these saplings are cut off in the same manner towards the end of summer, many fine specimens may be obtained from the infested stem.

Though the metamorphosis of beetle borers is identical with that of wood moths, their life histories are much more variable among the members of the different families of timber-boring beetles.

Many large beetles, such as the longicorns or weevils, lay their eggs in or upon the bark; and the resultant cylindrical or flattened naked grubs finally bore down into the heart wood before they pupate. When infesting fallen logs or dead trees, they usually pack the gnawed wood dust behind them as they gnaw out their parallel galleries, and finally, when they have pupated and changed into the perfect beetle, with the aid of their powerful jaws, cut their way out to the surface. Some develop within the year, but others may remain, under suitable conditions, for years feeding upon the wood before they pupate and become perfect beetles.

In these two families of beetles it is the larva alone that does all the damage. The full-developed weevil or longicorn beetle, after it has cut its way out, spends the remainder of its beetle life on the tree trunk or branchlets, when, if it does eat, only nibbles the surface of the bark.

The other important timber-infesting beetles might be broadly classed as dead-tree or fallen-timber borers, and are found in or upon dead or dying trees, fallen timber, and seasoning timber even after it has been cut up into joists or flooring. They may be further subdivided into four main groups: scolytid beetles, bostrychid beetles, powder post beetles, and furniture beetles.

Scolytid beetles, popularly known as "Shot Hole" or "Pin Hole" borers, on account of the clean-cut circular holes which the adult beetles bore through the bark and sapwood. They feed upon the wood while they are constructing chambers in which they deposit their eggs. The resultant larvæ do not do a great amount of burrowing (none in some groups), but feed chiefly upon the exuding sap of the moist wood. From this habit they are popularly known in the United States as "Ambrosia beetles." These beetles can be collected while starting to bore into the freshly-fallen timber by cutting them out where the pin-hole and wood dust show their activities, or breeding the next generation out of the timber. These beetles can only live and feed in timber while it contains moisture; they are never found in dry or seasoned timber.

Bostrychid beetles are often known as "Auger beetles" because, though some are not much larger than the shot-hole borers, the larger species cut circular auger-like holes through bark and wood. These adult beetles bore into the timber when it is drying, and while feeding upon it deposit their eggs in the tissue in which the larvæ feed, and burrow until full fed, when they pupate in a cavity at the end of the last parallel dust-packed gallery they have gnawed out while feeding. Specimens of both these groups of beetles can be collected by the forest officer in the timber, dropped into a killing-bottle or tube of methylated spirits and sent to the Forestry Commission through the post. To save postage and damage in transit when dead, they can be shaken out of the killing-bottle, or removed from the spirits, and packed in a tin of sawdust. Sections of the infested timber 6 inches or a foot in length should also be secured, so that the larvæ and pupæ can be identified and examined.

"Powder Post" beetles, so called by writers on economic entomology because they finally reduce any wood they infest into fine powder which finally crumbles away to dust, are also known in Australia as "Sapwood" beetles because, when infesting our hard woods (Eucalypts), they never extend their depredations beyond the inner margin of the sapwood. These beetles do not touch timber until it has been seasoning for some months, and the larvæ will not live in moist wood. The beetles are seldom noticed, by outward indications of their presence, in the timber until some of the adult beetles cut their way out through the board, leaving the characteristic circular "flight" holes dotted all over the area occupied by the outer sapwood. Other species are found in rattan furniture, and when sapwood has been included in wood used for furniture the flight holes appear in the finished article. In hardwood floors and other constructional timber they also often do a considerable amount of damage if much sapwood has been left on the margin of the heart wood.

In collecting Powder Post beetles, the best method is to send sections as soon as the first flight holes are noticed; these sections can be placed in tins and the adult beetles collected as they emerge. When possible the popular as well as the scientific name of the timber infested should be attached to the infested section of timber sent to the Forestry Commission.

All the previously mentioned borers are natives of Australia, though some have a wide range beyond, and may be called cosmopolitan species. The true furniture beetles (with one exception), as far as we know, are, on the other hand, introduced beetles. The greater part of the damage is done to dry seasoned wood, chiefly New Zealand white pine. In Australia this is caused by the cosmopolitan furniture beetle (*Anobium striatum*), which is common in Europe, where it infests and reinfests dry seasoned oak, beech, elm, and other timber. When timber is infested by the furniture beetle it can be easily distinguished from the work of the Powder Post beetle, because the horny comb-like galleries criss-cross all through the board beneath the larger flight holes.

In badly-infested houses the beetles often swarm out in the summer months, and can be collected both on the floors or on the window panes.

The above notes are a brief outline of the damage caused by the different timber and furniture infesting insects, and how they can be recognised and collected by people interested.

The writer is very anxious to get a large series, or even a single specimen, of any of these insects to study and place in the insect cabinets. Any forest officer or other person interested can render valuable assistance to the timber industry by forwarding specimens and information regarding the specimens sent to the Secretary of the Forestry Commission.

THE THICK-SET AMBROSIA BEETLE.

(*Xyleborus solidus,* Eichhoff.)

Xyleborus solidus, Berlin Zeit., page 151, 1868.

This handsome little beetle is very easily recognised, and differs from all the other of our common timber-borers in the relative size of thorax and body compared to its length. It is a thick-set, shining black beetle, measuring under one-sixth of an inch in length. The legs, antennæ, and ventral surface are dark chocolate brown. Many specimens can be cut out of the logs in the end of the summer, and others may be found entering logs in the early autumn, in which the prothoracic segment is dull red, but this appears to be an immature coloration, though persisting for a long time, and maybe remaining through life in some specimens. As the prothoracic segment is nearly as long and as broad as the hind portion of the body, covered by the black wing-covers, these parti-coloured specimens have a very distinctive appearance. The whole of the outer surface of the beetle, above and below, is lightly clothed with delicate, fine, downy, grey hairs.

The rounded cylindrical head, situated in the centre of the underside of the prothoracic segment, is hidden from sight when the beetle is viewed from above. It is furnished with powerful cutting jaws, oval eyes, projecting slightly on the sides, and slender antennæ, with the terminal joints forming a club; the latter folded under the head when the beetle is at rest. The cowl-like prothorax is rounded and roughened in front, curving upon the sides and truncate behind, where it joins the wing-covers. The legs are well developed, and terminate in very fine larval claws, admirably adapted for clinging to the surface of the bark when they start to bore into it. The body is almost cylindrical, the wing-covers, which are finely striated, folding round the sides of the body, and sharply truncate at the apex.

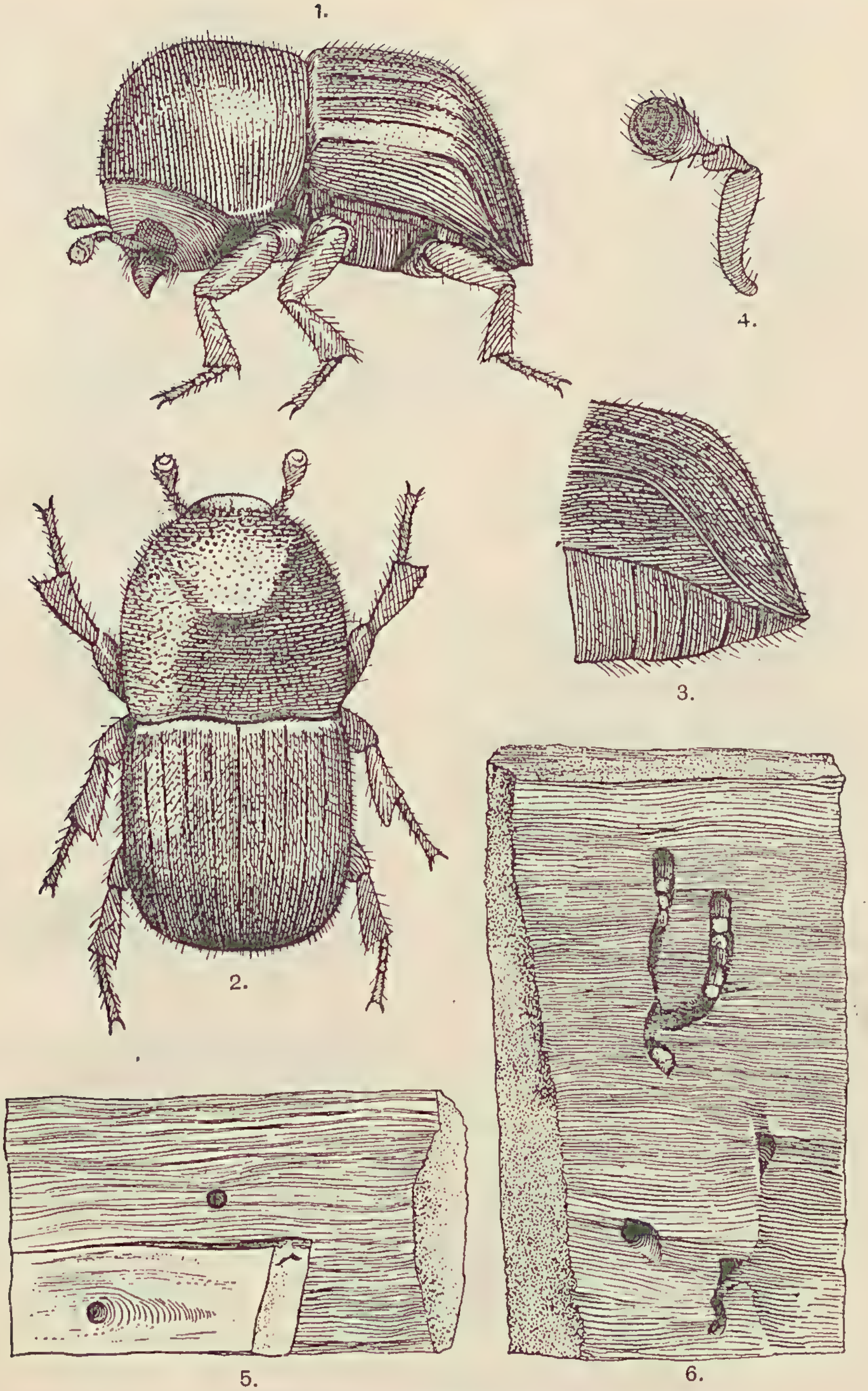
The beetles are very active in the summer months, and being furnished with well developed wings, folded beneath the wing-covers, can fly very well. They are attracted to fallen timber, and prefer the smooth-barked eucalypts of our coastal districts, ranging from Queensland southwards round to Western Australia.

In the summer they may be found well buried in the circular, closely-fitting pit in the soft bark, the day after the tree is fallen, and within a few days have entered the sapwood, in which, after they have penetrated to the distance of about half an inch, they commence to make their horse-shoe shaped galleries, in which they deposit their eggs at regular intervals, allowing room for the full development of each pupa, so that when the beetles have completed their metamorphosis they form a regular ring of from four to nine beetles head to tail. The action of the boring parent beetle causes the sap to exude and coat the surface of the chambers with a sweet, whitish substance, popularly called "ambrosia," upon which the larval baby grubs, developed from the eggs, feed and grow until they transform into the pupal state.

Apparently the early broods, at any rate, develop in the summer within six weeks or two months from the eggs to the perfect beetles. I cut out perfectly developed beetles packed in the galleries, as previously described, in a red gum log fallen six weeks previously in the Casino district, in the middle of March. If this log had remained undisturbed it is probable that most of these beetles would have remained in the protection of these galleries until the early summer.

I have collected these beetles boring into fallen logs of spotted gum (*Eucalyptus maculata*) over a large area of our southern forests, from the coastal blue gum (*E. saligna*), and several other species of gum in the northern forests, and from the Mountain gum (*E. dalrympleana*) and the mountain ash (*E. gigantea*) in the Batlow district. I have received specimens from Queensland, Victoria, and Western Australia. My previous references to this beetle were in the *Agricultural Gazette of New South Wales,* where in "Entomological Notes, 1900," I recorded this beetle under the title of the "Ambrosia Beetle" (*Xyleborus solidus*) as damaging apricot and apple trees. In 1903, in an article, "Some wood-boring beetles and their habits," I figured and described this beetle cutting off branches of apple trees by tunnelling their bores round the stem, beneath the bark. In all these cases of infestation of orchards the trees were in an unhealthy,

PLATE I.



Life History of the Thick-set Ambrosia Beetle.

Xyleborus solidus.

1. Lateral view of the adult beetle.
2. Dorsal view of the adult beetle.
3. Lateral view of the anal portion of wing covers and abdominal segments.
4. Enlarged view of antennæ.
5. Showing bore made through bark by the beetle when entering the tree trunk.
6. Section of sapwood of blue gum, showing galleries formed by the parent beetle, containing pupæ and immature beetles.

sapless condition; otherwise the trees would not have attracted the beetles.

This plate, illustrating the damage to the apple tree, was reproduced in "Australian Insects," but its native food trees were not recorded.

This widely dispersed beetle cannot be classed as such a serious timber pest as many of the smaller *Xyleborus,* which in suitable timber will bore considerable distances into the sappy timber before they cut their transverse tunnels, though at the same time they are frequently numerous enough to "shot-hole" much of the sapwood if the unbarked log remains for any time in the forest or mill yard.

THE HOOP PINE BARK WEEVIL.

(*Aesiotes notabilis,* Pascoe.)

The genus *Aesiotes* was formed by Pascoe, when he described this species, as the type specimen, in the *Journal of Entomology* in 1865, and figured head, thorax, antennae and tursi.

He described it from Queensland, but later in *Master's Catalogue* the definite locality of Pine Mountain, Queensland, and northern New South Wales were added. The specimens figured with this paper were collected at Brooklana, New South Wales, and the range of this beetle is probably that of its food tree, the Hoop Pine (*Araucaria Cunninghami*), found in Queensland and this State.

In 1873 Pascoe added two more species to the genus. One, *Aesiotes morosus,* was sent to him by French, who informed him that he found it on young saplings of *Eucalyptus viminalis* near Melbourne, Victoria. As far as the writer knows, nothing has since been recorded about its actual food tree or life history, and it is not a common beetle in collections. The third species, *Aesiotes lecurus,* was sent by Masters from Sydney, with the information that it was a serious pest to introduced conifers.

The writer has figured and described the life history of this beetle from specimens that finished up the destruction of the pine trees in Strathfield some years ago, and the plate illustrating it is reproduced in the *Forest Insects of Australia.* The Hoop Pine bark weevil is common in the pine forests of the Dorrigo districts. A fine series in all stages of development from the larvæ to the perfect beetles were obtained from a large pine tree (that had been blown down the previous year) at Brooklana, in the early part of December, 1923. The stout bark had been split along the fallen trunk, and it was along these parallel breaks that the larvæ had developed and constructed their remarkable pupal "nests" at this date, containing either larvæ, pupæ, or beetles.

The full fed larva, when ready to pupate, had eaten an elongate open cavity in the sapwood, about 1 inch in length and ¼ inch in diameter, tearing out the wood in long, slender strips, intertwining and curling it round and over the cavity into a rounded mass under the edge of the loose bark, about 2 inches in length and 1 inch across the middle. This is a very remarkable structure, and though the beetle forming it is only about the same size as the southern species (*Aesiotes lecurus*) the pupal "nest" is often nearly twice the size.

The adult beetle from the front of its turned-down head measures slightly over ½ inch in length. The general coloration is pale buff, with dull, reddish-brown markings on the sides and back, and the hind portion of the wing covers, including the two projecting spines, creamy-white.

It is not necessary to describe the general form, which is shown in Miss King's admirable drawing illustrating its life history.

BEETLE BORERS OBTAINED FROM TIMBER IMPORTED INTO NEW SOUTH WALES FROM BORNEO AND THE PHILIPPINES.

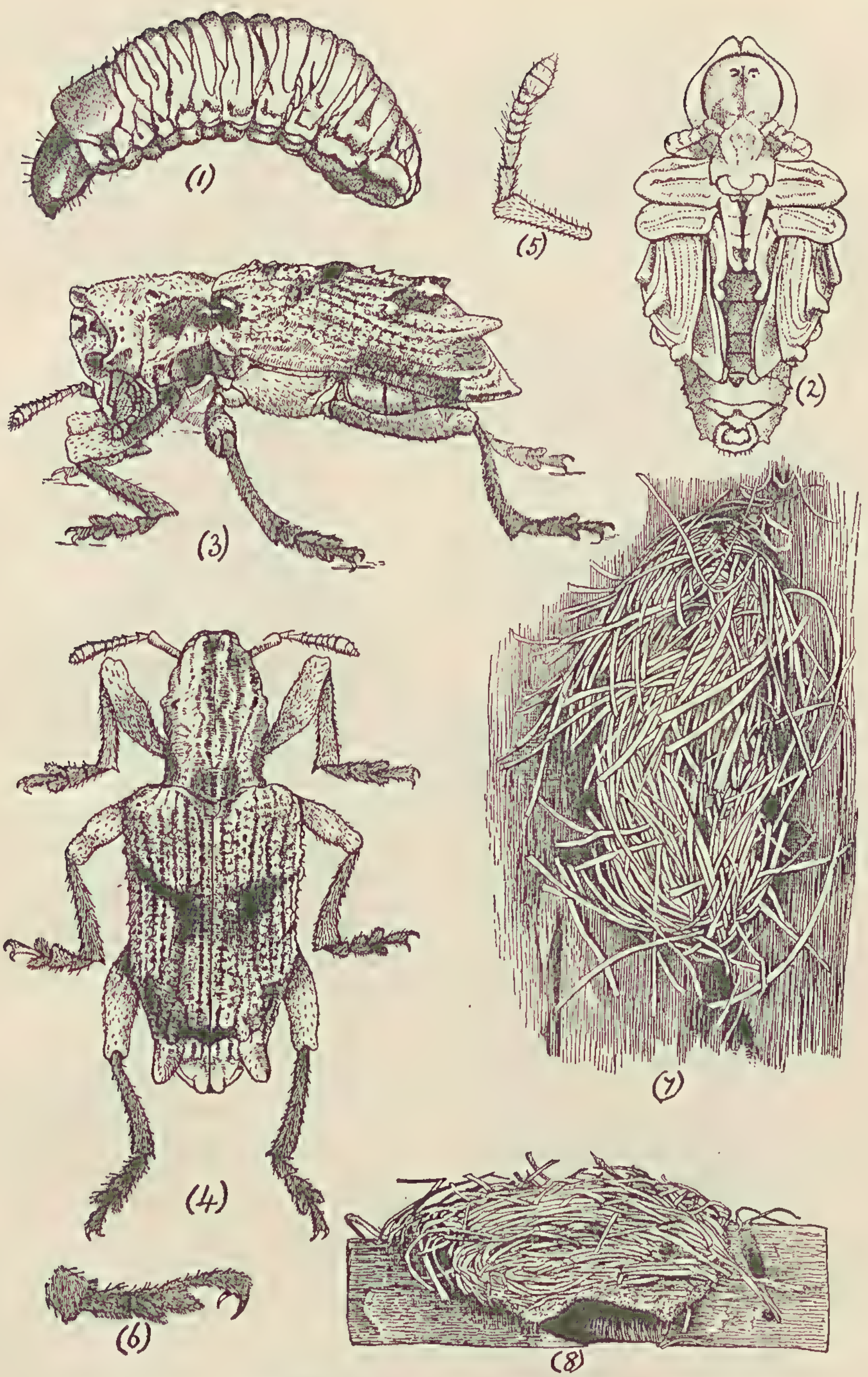
The bulk of the timber imported from these countries is known under the commercial names of "Red" or "White Lauan" and "Pacific Maple." It is the product of several species of fine forest trees belonging to the botanical genus *Shorea.* The genus *Shorea* comprises a number of useful timber trees that range over a large area of the East, from India to the Malay Archipelago.

Six species are listed under vernacular names in Foxworthy's "Timbers of North British Borneo."

Last year (1923-24) the Sydney timber merchants imported 203,577 feet in the log and 116,592 feet of sawn timber from

NATIONAL MUSEUM OF VICTORIA

PLATE II.



Life History of the Pine Bark Weevil.

Aesiotes notabilis.

1. Larva *Aesiotes notabilis.*
2. Pupa *Aesiotes notabilis.*
3. Lateral view of Beetle.
4. Dorsal view of Beetle.
5. Antennae Beetle.
6. Tarsus.
7.–8. The larval nest constructed on the edge of bark and wood by the larva before it pupates.

Borneo, the total value of which was £29,100. The timber of similar quality coming here from the Philippines is all sawn before transhipment from Manila; during the same period 1,346,593 feet were imported from this country, valued at £75,973.

Through want of shipping facilities, where the trees are fallen, or other delay in removing the barked logs out of the forest, many fine logs are badly "pinholed" before they are cut up or sent up to the depots. In the imported logs it is not an uncommon thing to find the outer, or sapwood, thickly perforated from the outer surface with fine pin-holes, due to the presence of small wood-boring beetles (family *Scolytidæ*). Frequently living larvæ and beetles are at work in the logs when they are being cut up, but as soon as the logs come under the saw the surface of the sawn timber begins to dry, and the adult beetles creep out of the bores, leaving the immature specimens and larvæ to die as the wood seasons. As all the outer "pin-holed" sapwood of the log is destroyed in the sawmill, it is not likely that any of these scolytid beetles could obtain a footing in our forests, though it has been suggested by newspaper writers.

In the sawn timber, however, quite a different family of beetles attack the seasoned wood: the Bostrychidæ, popularly known as "Auger beetles," are the most serious. In the course of the year the quarantine officers have on several occasions found boards showing evidence of this beetle infestation, and it is from this quarantined timber that I have obtained the beetles figured in this plate and described in this paper.

Timber containing Bostrychid or Lyctid beetles taken into the country could very easily introduce new timber pests into the State, if the beetles emerged later on and found suitable forest conditions or stacked timber containing sapwood, in which they could bore or deposit their eggs.

THE YELLOW-LEGGED AUGER BEETLE.

(*Xylothrips flavipes,* Illiger.)

This beetle has a wide range over the East, and has been recorded from India, China, Philippines, and the Malay Archipelago by Lesne, and more recently Scott has listed it from Madagascar, the Seychelles, and the Mascarene Islands.

Illiger described it in 1801. In Lesne's "Revision of the Bostrychidæ," which was published in the Annals of the Entomological Society of France in 1891, the writer redescribes this beetle, and places five others, previously described as distinct species, as synonyms of this widely distributed species. The first specimens obtained by the writer were working both in the beetle and larval state in some timber which came from the Philippines.

THE FEATHER-HORNED BORER.

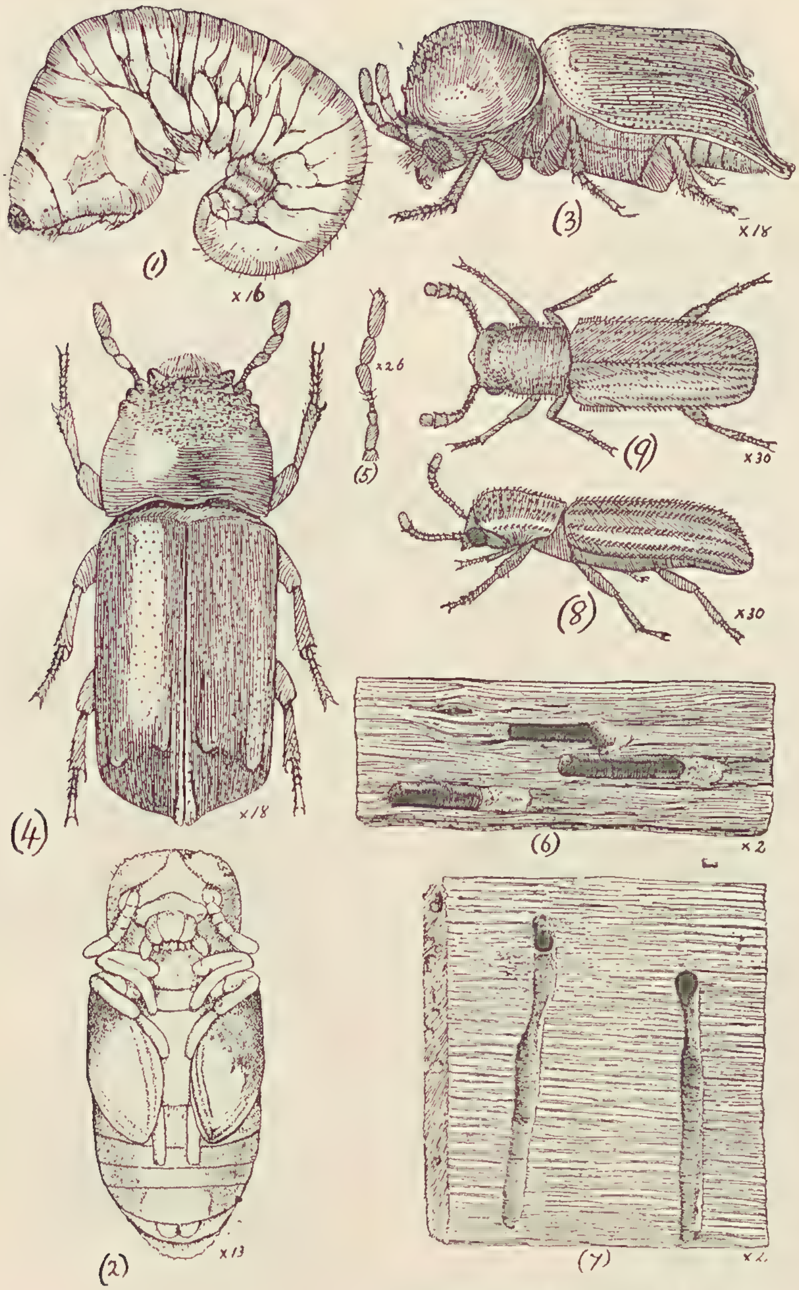
(*Sinoxylon anale,* Lesne.)

This beetle was described from the Philippines by Lesne in 1897 in the Annals of the Entomological Society of Belgium. In 1889 Blackburn described a borer from Port Darwin, Northern Territory of South Australia, under the name of *Apatodes macleayi* (Proc. Linnean Soc., N.S.W.). I have specimens named both *S. anale* and *S. macleayi* from Port Darwin, which are apparently identical.

This is a well-known borer with a wide range all over the East. Stebbing, in his "Forest Insects," records it as common in India. Bainbridge Fletcher, in his report (1919-20) figures this beetle, specimens of which he states were found in packing cases and the handles of brushes in Bombay.

Last July a large series of these beetles were found hard at work in the sapwood of a Red Lauan plank in a shipment of timber from Manila. There were no larvæ or pupæ in the damaged timber, which was tunnelled with parallel bores packed with wood dust, which crumbled away in the fingers. The beetle is a very active little creature, and when taken out of its burrow crawls about over the wood with its dainty pectinate antennæ standing out on either side of its head. It measures slightly over one-sixth of an inch, with the somewhat large cylindrical head turned down under the prothoracic segment, provided with small round, prominent eyes and shining black jaws. When at rest the antennæ are folded down on the sides of the head, the lower part of the head and prothorax are black, the wing covers are reddish brown, shaded with black down the centre of the

PLATE III.



Beetle Borers obtained from timber imported into New South Wales from Borneo and the Philippines.

Xylothrips flavipes.

1. Larva of *Xylothrips flavipes.*
2. Pupa of *Xylothrips flavipes.*
3. Lateral view of Beetle.
4. Dorsal view of Beetle.
5. Antennae of Beetle.
6–7. Showing damage caused by both Larva and Beetle.

Lyctopholis rugicollis.

8. Lateral view of Beetle.
9. Dorsal view of Beetle.

back, and on the truncate apical portion, the latter bearing short conical spines in the centre.

This beetle, like the preceding one, could be easily introduced into a new country with timber, and has possibly reached Port Darwin from the East.

THE YELLOW POWDER POST BEETLE.

(*Lyctopholis* (*Minthea*) *rugicollis*, Walker.)

This tiny powder post beetle is an active borer in the sapwood of the Red and White Louan timber from the Philippines, and as it is found in the dry seasoned sawn timber could very easily become established in our timber yards where this timber is often stacked in large quantities.

It makes regular parallel bores, packing them with wood dust, sometimes criss-crossing them, and the final pupal chamber is often larger than that of the typical *Lyctus*. The adult beetle cuts its flight hole straight up to the surface of the timber, and they emerge in the breeding tins all through the summer.

The beetle is about one-twelfth of an inch in length, and is of a uniform reddish brown tint; but the whole of the dorsal surface, and the legs and lower segments of the antennæ, are clothed with scattered yellow, peg-shaped, erect filaments that give it a distinct yellow tint. These filaments are irregularly disposed over the greater part of the beetle, except upon the wing covers where they form regular parallel lines as shown in the accompanying plate.

I have received specimens from Java sent by Mr. L. G. E. Kalshaven, Forest Entomologist at Buitenzorg, and it probably has an extended range over the Malay Archipelago.

THE HOOP PINE BUPRESTES.

(*Prosophores moesta*, Carter.)

THIS Buprestid Beetle was described under the name of *Buprestes moestus* by Carter in the Proceedings of the Linnean Society of New South Wales in 1915. The type specimen came from the Dorrigo pine forests, but nothing was recorded regarding its habits or life history.

Prior to taking up the study of the insects of the Hoop Pine in their native haunts, I had on several occasions received specimens of this beetle from Sydney householders, who had discovered them on the floors of their rooms or in the act of emerging through holes in the linoleum.

These beetles had cut their way through the floor covering after emerging from their pupal chambers in the Hoop Pine flooring boards, and these chambers had been formed in the logs before the timber had been cut into boards.

These beetles, under natural conditions in the forest, escape from the dead timber in the early summer months, mate, and lay their eggs in the bark of the fallen trees. I have found them on the foliage early in October.

The stumps of pine trees a few feet in height, and where the stem has been sawn off by the timber-getters, is a favourite situation. At Brooklana, in the end of August, I examined just such an exposed stump on the edge of the forest, and I obtained a large series of these beetles in all stages of development, from the immature larvæ to the shining black adult beetles.

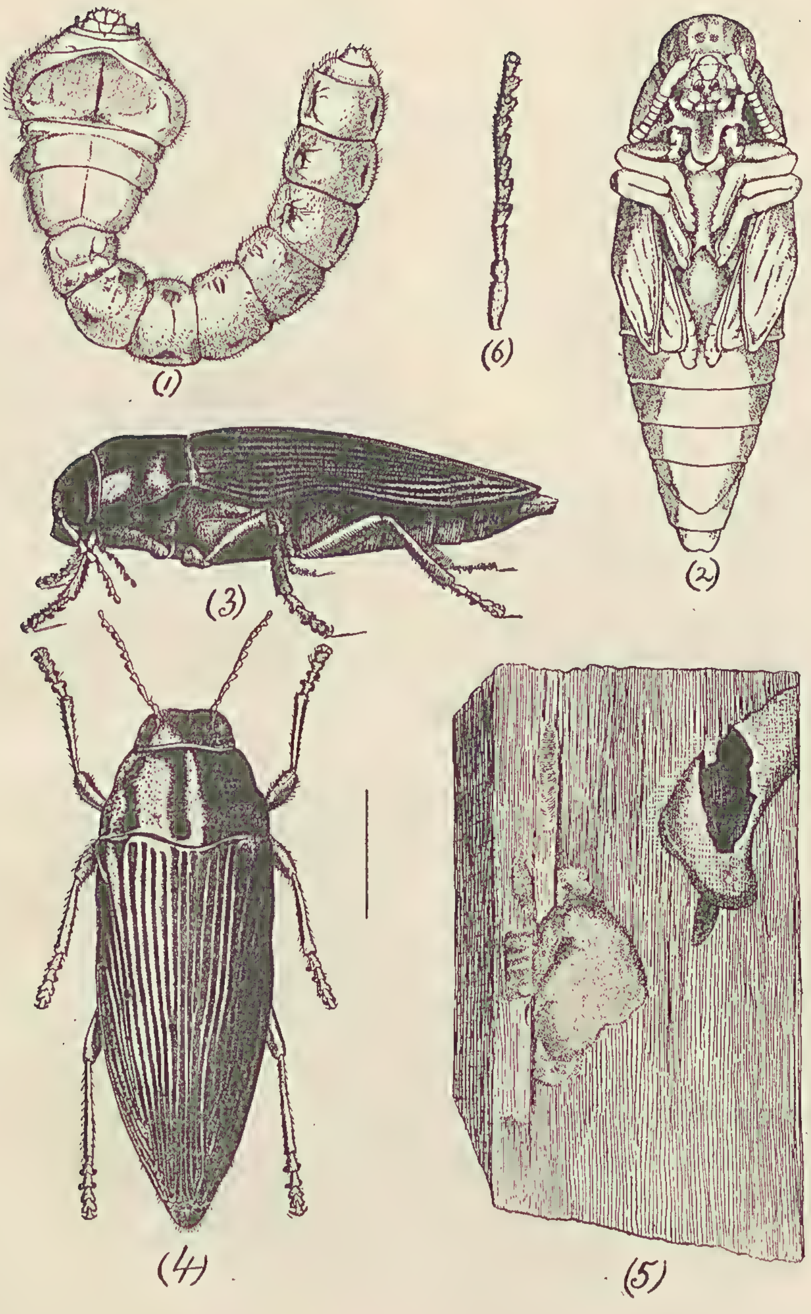
The slender, somewhat flattened, creamy white grubs do not penetrate far into the dry wood. They work just beneath the surface; and they form large irregular burrows packed with wood dust. The full-fed larva pupates in an oval chamber at the terminnation of the last tunnel, and the pupal chamber is usually parallel with the grain of the timber.

When a slice is chopped off the side of the stump the white, creamy-coloured pupa (often mottled with black when in an advanced stage of development) appears to be standing on the tip of its body, enclosed in its transparent pupal skin exactly like an Egyptian mummy.

The beetles vary slightly in size, but they average about ¾ inch in length, and are of the usual boat-shaped form of the typical Buprestid beetle. They are of a uniform shining black tint, with metallic reflections on the thorax. The head is closely and finely punctured; the prothorax is cleft down the centre and more finely punctured. The wing covers are very closely and deeply ribbed with fine parallel striae.

As the grubs usually confine their attention to the outer wood of the log, they are

PLATE IV.



The Hoop Pine Buprestid Beetle.

Prosophores moesta.

1. Larva of *Prosophores moesta.*
2. Pupa of *Prosophores moesta.*
3. Lateral view of Adult Beetle.
4. Dorsal view of Adult Beetle.
5. Cross section of block of Hoop Pine showing the damage caused, and the Pupal Chamber containing Beetle ready to emerge.
6. Antennæ of Adult Beetle.

not serious borers under normal conditions, unless they get well into the boards.

Another closely-allied species has been described under the name of *Prosophores aurantipicta.* It only differs from Carter's species in having four rows of irregular yellow blotches across the wing covers. These spots and markings are very variable; and it has been suggested that *Prosophores moesta* is only a variable form of the older described species. I have, however, taken a large series from one stump and only one of them had the slightest indications of yellow upon the wing covers. From my forest investigations I consider this a distinct species.

Note.—Later investigations have proved that *Prosophores aurantipicta* is a variegated variety of *P. moesta.* It is somewhat remarkable that while all the specimens I cut out of the surface wood of dead hoop pine stumps were of a uniform black colour, those coming out of floors are nearly all variegated, the golden yellow blotches on the clytra varying from two to eight in number. One householder lately brought in fourteen specimens which had emerged through the linoleum of his dining-room floor. It suggests that if the beetles feed in thicker wood, or remain for a longer period in the wood of the floors (usually over two years), they take on this varied colouration.

When the householder finds these beetles coming out of the floor he need not be alarmed about further damage to the timber, but he might fill the holes up with putty or beeswax.

THE HOOP PINE LONGICORN.

(*Diotima undulata,* Pascoe).

The cylindrical white grubs of this handsome longicorn beetle are to be found feeding between the bark and the outer wood of the hoop pine timber through the greater part of the year. Wherever a tree has blown over, these legless active larvæ will be found at work, or where the head of the pine has been left after the timber-cutters have taken out all the marketable timber, or where a standing dead tree remains in the forest with the bark attached.

Mr. R. Illidge, the well-known Queensland naturalist, writing about this beetle, says:—"It is common in fallen pine in the Gympie district, particularly when stripped of its bark for milling purposes." In the Dorrigo pine forests I have no record of its having infested barked logs, probably because the logs do not remain long enough in the forest to become infested, but I have cut the perfect beetles and pupæ in large numbers out of pine stumps left in the clearings at Brooklana in the early summer.

The range of this beetle is probably the same as that of its host tree (the Hoop Pine), over northern New South Wales and the coastal forests of Queensland. The handsome greyish brown beetles vary considerably in size. The larger female may be 1½ inches in length, though it is usually somewhat shorter. The male is more slender in form, and is often not more than ¾ of an inch in length. The chocolate brown ground colour of the head, thorax, and wing covers is delicately shaded with a wavy pattern of silvery-white pubescence, forming very distinctive markings on the wing covers; the under-surface of the whole insect lightly clothed with fine, downy white hairs.

The beetle lays her eggs in or on the surface of the dead rough bark. The tiny larvæ bore their way through the bark, and during the earlier stages of their development do not bore into the wood. They feed chiefly upon the under portion of the bark and the outer surface of the wood. When the grubs are reaching maturity they cut their way into the log, forming a characteristic keyhole bore. They plug up the opening of the bore with a mass of torn shreds of wood, which is sometimes merely a loose mass of filaments in front of, or surrounding it, and frequently becomes detached when the bark is torn off the decaying log.

The bore turns downward; the upper section, which is narrowest, packed with cemented wood dust, forming a protective barrier in front of the broader open chamber below, which is from 1½ to ¼ of an inch in diameter, and is 3 inches or more in length. This chamber is occupied by the elongated larvæ for some time before it pupates.

These beetles in the larval or grub state play an important part in the gradual disintegration of the decaying wood of the hoop pine logs which, under normal conditions, takes a very long time before it returns to wood mould on the forest floor.

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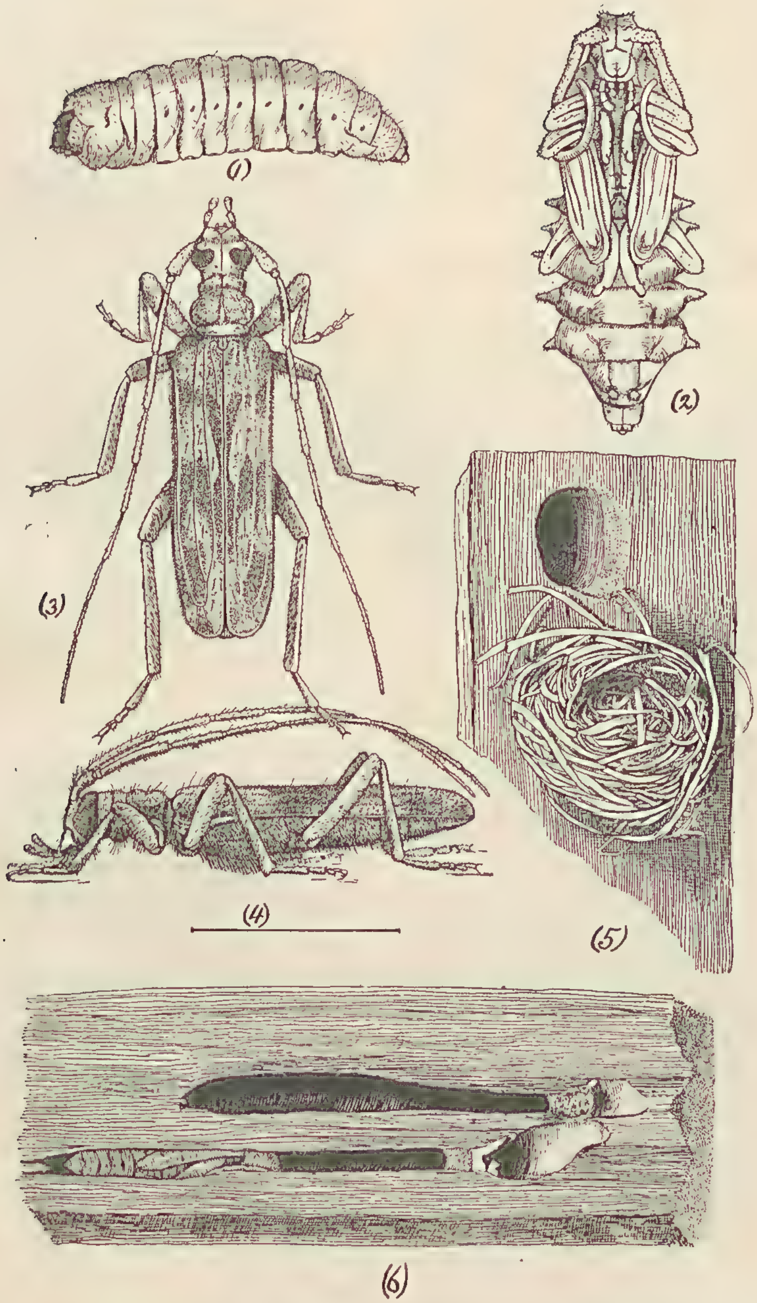
PLATE V.



The Hoop Pine Longicorn.

Diotima undulata.

1. Larva of *Diotima undulata.*
2. Pupa of *Diotima undulata.*
3. Dorsal view of the Beetle.
4. Lateral view of the Beetle.
5. Surface of pine wood with bark removed, showing the point of entry and opening covered with woody strips.
6. Section of wood showing pupal chamber with the outer ends plugged with wood dust.

The original description of this beetle was given by Pascoe in a paper entitled "On new Genera and Species of Longicorn Coleoptera, Pt. 4," contributed to the Transactions of the Entomological Society of London, in 1899. He gives a description of *Diotima undulata,* illustrated with a fine coloured plate of the female, and states that the specimens came from Moreton Bay.

SOME WEEVIL BORERS IN DEAD HOOP PINE.

The following paper is devoted to the description of some of the interesting weevil beetles (*Curculonidæ*), which are found in the hoop pine forests of the Dorrigo district, New South Wales.

They are found either in the stumps or in the trunks of the fallen pine trees, particularly where the back has split longitudinally in falling, and where decay has set in between the bark and the sapwood.

Some of these weevils confine their attention to the dry wood of the stumps, but others prefer the moist conditions of the decaying bark and timber.

The large pine stumps left by the timbergetters are usually barked by them for a distance of six inches or a foot below where the trunk is sawn off ; the outer surface then becomes dry, smooth, and hard. This smooth surface is the portion first infested by the beetles. Later they extend their burrows beneath the encircling bark.

When a dead stump is in this condition there is no outward evidence of the beetles and larvae which are feeding in the wood, because the minute holes made by the minute larvae, hatching from the eggs which have been deposited by the beetles in the surface of the wood, do not show on the weathered surface of the stump.

The Buff-coloured Pine Weevil.

(*Mitrastethus australasiæ,* Lea.)

All throughout the year this is the most numerous beetle in the stumps, also it does occasionally turn its attention to the fallen pine logs if they remain in the forest for any length of time after they have been cut and barked. When the outer surface of the dead stump is chopped off, within less than half an inch, the whole of the wood is found to be honeycombed with lateral bores of varying size and extent. These run back into the stump for several inches ; some of the smaller bores are closely packed with wood dust, but the larger ones, up to one-sixth of an inch in diameter are often comparatively free from packing when they contain the full fed larva, pupa, or adult beetle.

The dull-white legless larva, has a smooth shining, reddish-brown head, furnished with small black jaws. The thoracic segments are larger than the first abdominal segments, the terminal ones smaller, and the anal one rounded at the extremity ; all the segments are deeply corrugated and rounded on the sides. When extended the body of the full fed larva measures about one-third of an inch. It pupates in the lower portion of the final burrow loosely surrounded with wood dust.

The beetles when first cut out of the wood, are of a uniform pale buff colour ; but many of them when dry and pinned change to a dark, brown. They vary in size, but with the head tucked in under the prothorax (the usual attitude) they average about one-fourth of an inch in length.

The whole external surface of the beetle is clothed with pale golden, yellow scales which vary somewhat in shape ; these upon the dorsal surface of the wing covers and thorax are flattened, circular, and fit closely together ; those upon the undersurface legs, and head are more elongate and not so closely in contact with each other. Besides this, the whole surface is covered with scattered pale golden filament, or slender pear shaped scales standing out above the armour-plated surface. They form parallel rows upon the dorsal surface, but on the sides, head, and legs they are irregular in their arrangement.

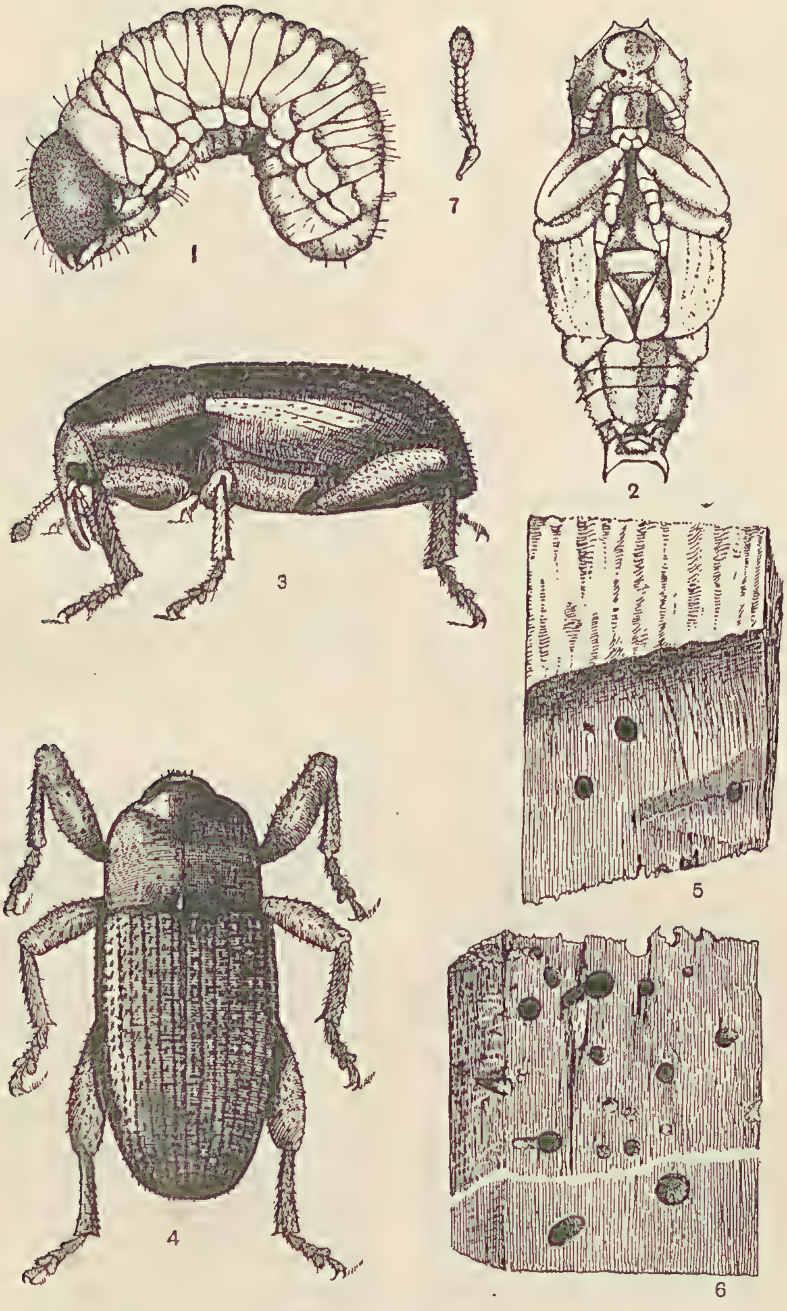
The antennæ and rostrum are reddish-brown fringed with stiff hairs, and the tip of the latter is black.

Some of the freshly emerged specimens of the beetles when pinned show indistinct black markings and spots on the wing covers.

This is the only species of the genus described from Australia, but *Mitrastethus bituberculatus* found in pine trees in New Zealand is clothed with similar plates and filaments.

Lea described our species from northern New South Wales and Queensland in 1908 in the "Memoirs of the Entomological

PLATE VI.



Pine Stump Weevil.

Mitrastethus Australasiae.

1. Larva *Mitrastethus Australasiae.*
2. Pupa *Mitrastethus Australasiae.*
3. Side view beetle.
4. Dorsal view beetle.

5 and 6. Pine wood damaged by weevil larvæ.

7. Antennae of perfect beetle.

Society of Belgium," and lists it, and defines the generic characters in the "Proceedings of the Linnean Society of New South Wales" in 1909.

The Shining Reddish-brown Weevil.

(*Bepharus ellipticus,* Pascoe.)

This handsome little weevil is found on the dead pine trunks were the bark has broken away and decay has set in along the exposed portion.

It measures about one-eight of an inch in length. It is of a uniform bright shining reddish brown colour. The head is smooth, the prothorax has a few very fine punctures in front on the centre, with three circular pits (*fovea*) forming a triangle on the hind portion. The wing covers are closely ribbed with fine parallel striæ impressed with fine punctures. The prothorax is rounded on the dorsal surface forming a triangle when viewed from above. The wing covers are elliptical, rounded, curving in on the sides, above the apex the tips are flattened out, rounded on each side with a distinct cleft between them. The legs are stout, with the apical portion of the thighs thickened. This beetle was described and figured by Pascoe in the "Transactions of the Entomological Society of London" in 1870. In the "Proceedings of the Linnean Society of New South Wales" Lea redefines the genus *Bepharus* and gives a technical description of the species. He says "A highly polished species which should be easily recognised on account of three large punctures or small fovea on the prothorax, and the peculiar flattening of the apical portion of the elytra. He gives the habitat as Wide Bay, Queensland.

The Flat-backed Black Pine Weevil.

(*Sympiezosceles spencei,* Waterhouse.)

This beetle is found in similar situations to that of the previously described species, and I have taken them mixed up together on the same decaying bark. They were fairly common in the Dorrigo, New South Wales, in the middle of December.

This is a broad backed shining black weevil with the front of the prothorax and the tips of the wing covers rounded giving it a general oval form with the head turned down in front. The prothorax impressed with fine scattered punctures. The wing covers are closely ribbed with fine deep punctured striæ. The legs are short with the swollen thighs flattened laterally ; the tibia short, rounded at the base and truncate at the apex. Broad in proportion to its length, this beetle measures about one-half an inch in lenghth.

When Waterhouse described this beetle in the "Transactions of the Entomological Society of London" in 1853, he doubtfully gave its native land as New Zealand, so it is not listed in "Master's Catalogue," Lea calls attention to its Australian origin in his paper in the "Proceedings of the Linnean Society of New South Wales."

The Floury Pine Weevil.

(*Dryopthorus corticalis,* Say.)

This small weevil with other specimens was identified for me by Mr. A. M. Lea, from specimens obtained in the pine forests of Brooklana, Dorrigo, New South Wales. The genus *Dryopthorus* was formed by Schonherr in 1826, and contains a number of small dark coloured weevils which live under bark of dead or decaying wood, or bore into the dry wood of deciduous or coniferous trees. The members of the genus have a wide range; two are recorded from North America but most of the species have been collected upon isolated islands, one is described from New Zealand, two from Madagascar, one from New Caledonia, another from Fiji and Ceylon. In the "Fauna Hawaiiensis" Dr. Sharp has described seventeen species from the Hawaiian Islands.

Our species was described from North America by Say in a paper entitled "Description of Curculonidæ of North America in 1831.

A large number of these little weevils were found clustered together in cavities in the top of a dead hoop pine stump, which was thickly tunnelled by the larvæ of the Buff-coloured Pine weevil (*Metrastethus australsaicæ*). When disturbed they remained motionless with their legs and antennæ contracted on their sides, though no larvæ were obtained, they appeared to have bred out of the surrounding damaged wood or bark, and collected in the cavities in the top of the stump. This beetle measures nearly one-fifth of an inch in length, and might be compared to one of the common grain weevils but is stouter and more robust in form ; the ground colour is black, with the antennæ and apical portion of the legs

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reddish-brown, the terminal club of the former oval in form, and shining, the latter with large tibial spines curved inwards. The whole surface of the beetle, including even the legs and the head down to the tip of the rostrum, deeply pitted with circular punctures, while the wing covers are deeply and closely ribbed with deep parallel striæ which carry rows of rounded pits. When collected out of the wood these beetles are plastered with a pale yellow woody substance, which shows no definite structure under the microscope, but as it flakes off the body it remains in the striae and punctures giving the beetle a decidedly greyish tint.

If this beetle is identical with this North American species it is certainly well established in the hoop pine forests of the Dorrigo district.

THE SPOTTED GUM SCOLYTID BORER.

(*Crossotarsus armipennis,* Lea.)

THIS active little beetle borer is the only member of the cosmopolitan family *Platypodidæ,* which is common in freshly-fallen gum-trees, and, as far as I know, it confines its attention to one species, our coastal Spotted gum (*Eucalyptus maculata*).

Nearly all the members of this important family are popularly known as "Shot" or "Pinhole" borers, on account of the clear-cut holes they make through the outer surface of the felled timber, and chiefly confine their attention to the brush timbers of the coastal forests. They seldom attack the hardwoods.

This species was described by Lea in the Proceedings of the Royal Society of Victoria, 1909, from specimens in the Macleay Museum. The locality was given as New South Wales. In the same paper he described a second species, *Crossotarsus sub-pellusidus* from Cairns, North Queensland. Two other species originally recorded from the Malay Archipelago (*C. mniszechi* Chap. and *C. cavifrons* Blndf.) were also recorded from Queensland.

The members of the genus *Crossotarsus* are closely allied to those of the genus *Platypus.* They are chiefly confined to the Malay Archipelago, New Guinea, and Australia, and the habits and life histories of both groups are very similar.

Through the kindness of the District Forester at Wyong, Mr. McPherson, who takes a keen interest in forest insects, I have been able to observe this active little borer at work on freshly-felled spotted gum logs. I have worked out its life history in the forest.

In the early part of October, 1924, Mr. McPherson sent me a large number of living specimens of these beetles. He said that they were boring into all the freshly-fallen spotted gum logs in the Wyong and Morisset districts.

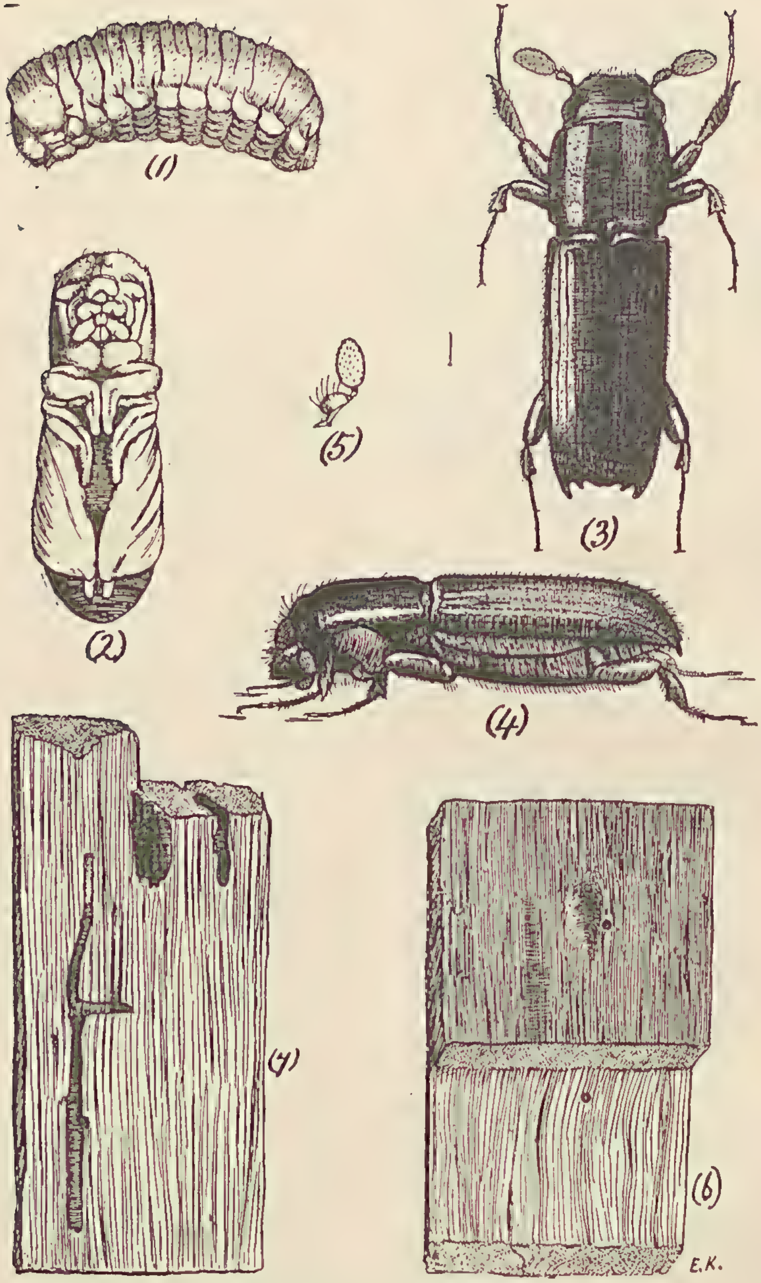
I paid a visit to Morisset a week later. I was shown a tree that had been felled two days previously. It was thickly infested with dozens of these beetles. Some were just starting their cylindrical shafts into the smooth bark; others were completely hidden in their burrows; a few had even started to enter the sapwood after cutting through the thick bark.

As the beetles were evidently just emerging from their winter quarters, a search was made, and a spotted gum log, to which most of the bark still adhered, was found. This tree had been felled and left on the ground about a year previously. Close investigation showed that it was the home from which the spring brood of the present beetles was emerging. On splitting sections of this log, the parallel galleries formed by the adult beetles for the reception of the eggs were exposed to view. Many of these galleries still contained the dormant beetles, just ready to emerge. The structure of these characteristic burrows are well shown in Miss King's admirable plate upon the life history of this beetle.

The eggs are laid in these parallel galleries. The larvæ do not gnaw the wood, but feed upon the sugary fermenting sap which exudes from the surrounding wood tissue in the course of drying. This sap is known as ambrosia.

In North America insets in allied groups are called Ambrosia beetles. These larvæ, as already mentioned, obtain their nourishment from the ambrosia which is not produced after the sapwood seasons. Therefore their earlier stages of larvæ and pupa are comparatively brief, and they remain in these chambers as immature throughout the winter. Although the spotted gum has a very wide range along the coastal areas of this State, the only localities from which

PLATE VII.



Life History of Shot-hole Borer.

Crossotarsus armipennis in Spotted Gum (*Eucalyptus maculata.*)

1. Larva of *Crossotarsus armipennis.*
2. Pupa of *Crossotarsus armipennis.*
3. Adult beetle dorsal view.
4. Adult beetle lateral view.
5. Enlarged drawing of antennæ.
6. Bark of Spotted Gum showing entry hole of the beetle.
7. Sapwood of Spotted Gum showing the galleries formed by the beetles for the larval and pupal chambers.

I have collected specimens are the Morisset district and Glen Innes. Further research will probably extend their range.

The beetle is cylindrical in form, and measures about $\frac{1}{6}$ of an inch. The female is usually slightly longer than the male. The general colour is black, with the antennæ and legs reddish-brown. The head, fitting close into the prothorax, is truncate in front, sloping down from above the eyes to the mouth parts. It is impressed with scattered fine punctures, and fringed with fine reddish-brown hairs below the eyes, extending round to the jaws.

The prothorax is truncate in front and, with the exception of a few fine punctures on the front margin, is smooth and shining The wing covers fitting closely round the abdominal segments, are marked with fine punctuate striæ. The sexes differ in the structure of the tips of the wing covers. The male has the apex rounded, clothed with very fine scattered hairs; the centre of the wing covers concave with the margins turned up, and the outer portion produced into a pair of stout spines, the inner one smaller and turned downward. The female has the same fine hairs on the rounded extremity of the wing covers; the central tip concave, but the sides rounded, without any projecting spines.

PREDATORY PARASITES OF TIMBER-BORING BEETLES.

Most timber infesting insects have their own special enemies, and these play a very important part in the forest in keeping the pests down to normal conditions. Many of these enemies are beetles, which hunt over the tree trunks for the shot-hole and pin-hole beetle borers which are attracted to freshly-felled trees in the forest. The beetles responsible for the destruction of timber borers attack them in two different ways; first, through the agency of their larvæ; second, by direct action. In the first case they deposit their eggs in or upon the bark of a dying tree, or on a freshly-felled log in the forest, under which their wonderful instinct tells them there are timber borer larvæ at work. The resultant larvæ are just as much at home in the wood as the larvæ of the wood borers, and they can work their way under the bark and along the wood dust packed galleries (excavated by the borers) until they overtake their prey, which they promptly devour and then continue their quest. When full grown (the life cycle usually taking about a year) they pupate in the end of the chamber in which they have had their last feast.

Under varying conditions of heat, moisture, or food supplies they may remain as active larvæ, or quiescent pupæ for a longer period; but when they have undergone their final metamorphosis and have cast the pupal skin, and appear as perfect beetles, they set to work to make their way out through the perforated wood. They usually have no difficulty in reaching the surface through the old galleries of the timber borers, but occasionally one finds a dead one that has missed the track, and stopped in an unfinished gallery.

In the case of direct action, it is the perfect beetles that hunt and destroy the timber boring beetles while they are feeding or engaged in excavating galleries and chambers to contain their eggs and protect their larvæ.

In some families, however, the larvæ only are carnivorous and feast upon noxious insects, but the adult beetles are vegetarians.

The most numerous and active predatory larvæ are those of the family *Cleridæ*. These larvæ are slender, yellow or pinkish coloured creatures, clothed with fine hairs, furnished with three pairs of legs, stout jaws, and the head and thoracic segments armour-plated with chiton. The life-history of one of our largest species (*Trogodendron fasciculatum*) a common enemy of longicorn beetle larvæ has been figured and described in my "Forest Insects of Australia, 1923."

Not only are the larvæ carnivorous, but in the tree trunks of freshly-felled trees, where "shot-hole" borers are at work, Clerid beetles are frequently found in the tunnels devouring the helpless borer, trapped in his tunnel, in which he has no means of escape from the ferret-like enemy at his back.

When chopping up sections of seasoned timber, or dry logs, living beetles as well as living larvæ and pupal forms are often exposed, these having developed after the log has been removed from the forest and milled.

The Variegated Cylidrus.

(*Cylidrus basalis,* Macleay.)

This handsome little beetle was originally described by Macleay in his paper entitled "The Insects of Gayndah, Queensland," published in the second volume of the "Transactions of the Entomological Society of New South Wales, 1866." I have obtained several specimens when cutting out the little thickset shot-hole borer (*Xyleborus solidus*) burrowing in the trunks of felled Blue Gums (*Eucalyptus saligna*) in the Brooklana district, Dorrigo, New South Wales.

They enter the open burrow made by the borer through the bark and attack him in the rear, feasting upon the helpless *Xyleborus,* which, fitting close into his cylindrical tunnel, can neither move forward nor backward.

This ferret-like beetle with his powerful jaws soon finishes his feast, and I found one resting in a burrow with only the remains of the wing covers of the victim. This slender, active beetle is well adapted in form for the life it leads. The head, the prothorax, apical joints of the antennæ, upper half of the wing covers, and the tip of the body shining blue-black; the palpi and the basal joints of the antennæ reddish-brown; the yellow legs blotched with darker brown; the lower half of the wing covers and the rest of the abdomen bright reddish-brown. The upper surface of the head very finely punctured, the prothorax finely shagreened, and the wing covers very slightly punctate. The whole of the upper surface of the beetle lightly clothed with fine hairs. About one-third of an inch in length.

The Black Cylidrus.

(*Cylidrus nigrinus,* White.)

This larger shining black clerid beetle has similar habits to that of the previously-described species (*Cylidrus basilis*), and probably has a similar range through our hardwood forests where shot-hole borers are at work. I have found it more numerous, and besides collecting them in the Brooklana district in the early summer in the burrows of *Xyleborus solidus,* I obtained two specimens later in the year at Batlow, New South Wales, in the Mountain Gum (*Eucalyptus dalrympleana*) logs, where they were investigating the tunnels of the same shot-hole borer. This species was originally described by White, from Tasmania, in the British Museum Catalogue, Coleoptera (vol. IV, 1849).

Its general colour is shining black, the antennæ brown on the base, with the apical segments black; the forelegs black with reddish-brown tarsi; the middle and hind legs pale yellow, with the tarsi and portion of the shanks reddish-brown; the abdomen of which the last two segments extend beyond the tips of the wing covers, vary from reddish-brown to yellow.

The general slender semi-cylindrical form of this active beetle is admirably adapted for the hunting life that it leads on the fallen tree trunks. Measuring from the tips of the curved projecting mandibles to the extremity of the exposed abdomen, it is slightly under half an inch in length.

I have been unable up to date to identify the larvæ or investigate the early stages of the development of this beetle, but it is evident that its carnivorous larva lives upon other wood-boring grubs, for I have cut another species out of seasoned timber which was riddled with wood borers.

This and allied species of clerid beetles must play an important part in the destruction of timber-destroying beetles.

The Slender Colydid.

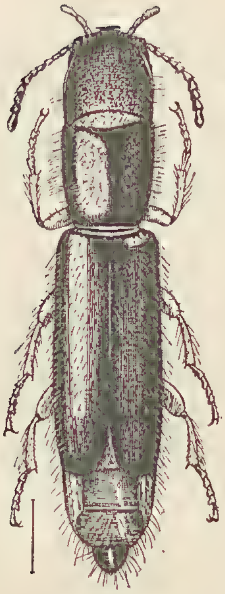
(*Gemphylodes tmetus,* Olliff.)

This remarkable looking beetle was originally described by Olliff in his "Insect Fauna," a section of a bulletin published by the trustees of the Australian Museum, "Lord Howe Island, its Zoology, Geology and Physical Characters, Sydney, 1889."

The genus is a restricted one, another species (*Gemphylodes lewisi*) was described from Japan by Dr. Sharp in a paper entitled, "On the Cucujidæ," collected by Mr. George Lewis in Japan in 1885, in which the species was figured in the nineteenth volume of the Linnean Society of London. A third species has been described from the East by Pascoe, one, I have cut out of seasoned Red Lauan timber from the Philippines, in borer-infested sapwood, is probably Pascoe's species. Olliff states that our species is easily distinguished from these species by the densely punctured and ridged prothorax.

Two of my specimens were collected crawling over a felled log in a sunny track in the forest at Brooklana, and a third cut

PLATE VIII.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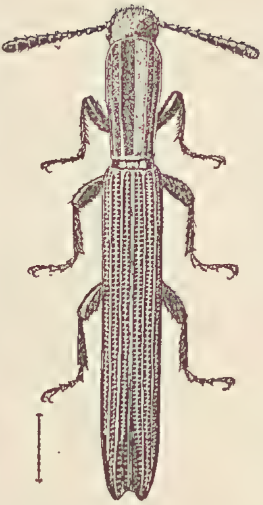
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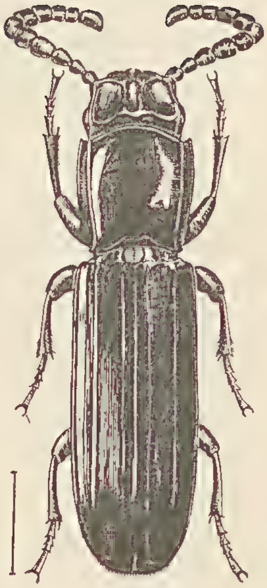
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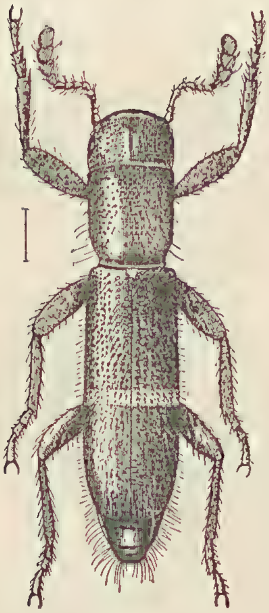
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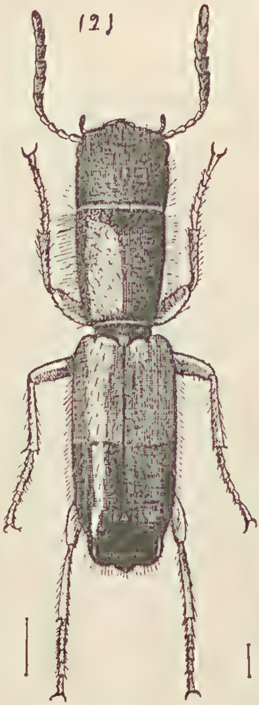
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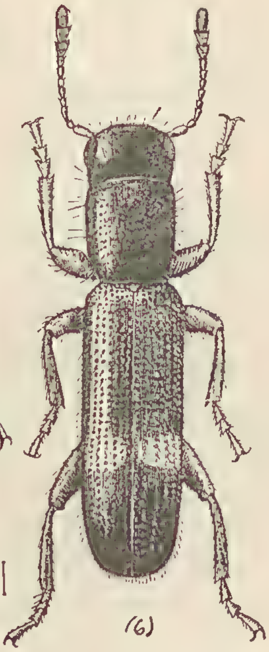
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Predatory Parasites upon Timber-boring Beetles.

1. *Cylidrus nigrinus.*
2. *Gemphylodes tmetus.*
3. *Hectarthrum brevifossum.*
4. *Paratellus carus.*
5. *Cylidrus basalis.*
6. *Tarsostenus univittatus.*

out of a sassafras log infested with pin-hole borers (*Platypus australis*). There are specimens in the Australian Museum collections from Maryborough, Queensland.

Its remarkable form is very difficult to describe in words, as will be seen in Miss King's illustration. It is of a uniform shining black colour, even the folded wings beneath the wing covers are black, and measures under half an inch in length.

The Large Black Cucujid Beetle.

(*Hectarthrum brevifossum,* Newman.)

This curious beetle varies so much in size and has such a wide range that it is no wonder that it has been described and redescribed under a number of different names.

In Newman's definition of the genus *Hectarthrum,* published in the Annals and Magazine of Natural History in 1839, he describes *Hectarthrum brevifossum* from specimens in the Hope collection from Java, and says *Cucujus heros* Fabr. comes from Sumatra.

Waterhouse, in a paper on this family, published in the "Entomologists' Monthly Magazine," 1876, gives the range of this beetle (*H. brevifossum*) as India, Java, Borneo, Siam, Timor, Philippines, Burma, Amboyna, and North Australia. He further says that *H. heros* Fabr. is unknown to him.

In Masters' "Catalogue of the Described Coleoptera of Australia," the former species is recorded as widely distributed over Australia. Schultze, in his "Catalogue of the Described Coleoptera of the Philippines, 1915," however, gives *Hectarthrum heros* specific rank, and makes Newman's *H. brevifossum* a synonym of the former, together with Castleneau's *H. bistriatum.* As this beetle has been known so long to Australian entomologists under Newman's specific name, I have not altered it in this paper. Besides collecting this beetle in many parts of Australia, I have on several occasions cut it out of beetle-infested sapwood of Red Lauan timber from the Philippines.

White-banded Clerid.

(*Paratellus carus,* Newman.)

This small clerid beetle is one of the most numerous and active predators upon the smaller timber borer beetle larvæ. It is found both in the forest upon felled logs, and running over the stacks of sawn timber in the mill yards. When splitting up timber infested with powder-post beetles (*Lyctus sp.*), one constantly exposes their typical slender larvæ, or the resting clerid beetle covered with wood dust, in the empty burrows of the *Lyctus,* which they have devoured. It is common in "crab apple" and other brush woods of our coastal scrubs if they are cut up with the sapwood suitable for *Lyctus* infestation, and are found under similar conditions in the hardwood timbers and Queensland maple. When the adult stage is reached the beetle cuts its way out through the surface of the timber, often dislodging more dust round the exit hole than the powder-post borers. As they are often found running about on felled gum trees, they probably attack and devour other small bostrychid beetles when they are depositing their eggs in the wood cells. They deposit their own eggs in the bark or cracks in the surface of the wood, and the resultant larvæ worm their way through into the wood-borers' galleries and feed upon any larvæ they find. Their larvæ can be easily identified from those of the wood borer by their elongate form, well developed legs, armour-plated prothorax, and horny head furnished with a pair of projecting jaws.

The adult beetles vary somewhat in size, the largest reaching to about one-third of an inch in length. The coloration of this little beetle is variable. When a large series is examined the red, blue and black tints are diverse. Usually the head, prothorax, and the basal joints of the antennæ are rich reddish-brown, with the apical joints of the antennæ black; the legs are dark reddish-brown. Sometimes the head is almost black, and the legs have a darker tint. The wing covers are dark shining blue, the basal portion deeply and closely punctured, and divided from the brighter coloured, smooth apical half by a narrow transverse white band; they are rounded at the extremities above the exposed tip of the abdomen. The whole insect, including the legs and the antennæ, is clothed with blackish and grey hairs, the latter colour upon the legs and undersurface. This beetle was originally described by Newman under the name of *Clerus carus,* in the "Entomologist," in 1840, the locality given was New Holland, but he stated he had received the type specimen in a collection from Sydney.

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In 1878 Gorham recorded it from South Australia in the "Transactions of the Entomological Society of London." It has a wide range over Australia.

The Small White-blotched Clerid.

(*Tarsostenus univittatus,* Rossi.)

This little clerid frequently comes into Australian ports with timber and packing infested with borers. I obtained a large series from the wood of a tea chest riddled with Bostrychid beetle larvæ (*Heterobostrychus aequalis*), which came in a shipment from India, and was stopped by the quarantine officers.

I have also cut them out from sawn "Red Lauan" or "Pacific maple," timber imported from the Philippines. The timber from the Philippines when containing sapwood being often damaged both by the larvæ of powder-post beetles (*Lyctus spp.*) and the larvæ of a Bostrychid beetle (*Xylothrips flavipes*), and I believe this clerid beetle and its larvæ destroy the larvæ of both these wood-borers in their burrows, for I have collected both stages in their excavations. I have on several occasions found the beetles among stacked timber in the Sydney mill yards, but have never taken it far away from the wharves, therefore I do not think it has yet become established in Australia. This is rather curious, because, according to Schultze (previously quoted), it has been described under five other names and recorded from England, South Africa, North America, Europe, India, and the Malay Archipelago, with a wide range over all the Philippine Islands.

In general form, it will be seen by reference to the accompanying illustration, it resembles the previously described Australian species. Though variable in size, it is smaller, rarely measuring over one-eighth of an inch in length. The general coloration is black, with the basal joints of the antennæ, apex of the thighs, tibiæ and tarsi of the legs reddish-brown. The upper surface of the head and prothorax irregularly but closely punctured; the wing covers also thickly punctured, the pitting forming regular parallel lines to the tips of the wing covers. An irregular blotch of creamy white on either forming a transverse broken band across the centre of the elytra. The whole insect clothed with scattered fine white hairs. In the *Journal of Agricultural Research,* 1924, Washington, U.S.A., R. A. St. George gives an interesting account of the "Egg and First-stage Larvæ of *Tarsostenus univittatus,* Rossi, a Beetle predaceous on Powder-post Beetles," and he figures the different stages described.

He says: "This is one of the principal predators on powder-post beetles in the United States." He quotes Champlain, another American writer on the *Cleridæ,* who says: "Under natural conditions they may be of normal importance, but can be turned to considerable account in control measures with the additional help of man, who can overbalance the natural conditions in favour of the predators by properly conducted control work."

THE CYPRESS PINE BEETLE.

(*Diadoxus erythrura,* White.)

One of the dominant features of the western areas of New South Wales and a great part of inland Australia is the scrub forests, and the most prominent trees in these dry land forests are the Cypress pines.

Years ago they were grouped in the Genus *Frenella,* but modern botanists have now placed them in the Genus *Callitris* created by Ventenat in 1818. The eighteen species, listed by Messrs. Baker and Smith in their "Pines of Australia," are restricted to Australia and Tasmania. Most of these are inland forms, but they are widely distributed over the continent. One, *Callitris Muelleri,* is found on the north shore of Port Jackson; *Callitris cupressiformis* in the coastal forests of the northern rivers of New South Wales, and a third species, *Callitris intertropica,* grows on the north coast of Australia. The two species most widely scattered over New South Wales are *Callitris robusta* (White Pine), and *Callitris calcarata* (Black Pine).

In north-western Victoria and the Riverina the settlers used to call them "Murray Pines," while the explorers and pioneers designated them as "Desert Cypress."

The sawmillers and timber-getters consider that the White Pine is very much superior to Black Pine. They claim that while the former can be used for both inside and outside work, and for fencing posts, that will last for ages, the timber of Black pine is much inferior for outside purposes. There is some doubt if this be absolutely correct; and the different class of country in which the same or different species develop may be responsible for their durability.

All the Cypress pines are remarkably hardy trees, and can hold their own through protracted droughts. Both as living trees and when converted into sawn timber the wood is immune to damage by white ants (termites). Yet the country in which they grow is swarming with white ants, feeding upon fallen logs and stumps, and after heavy rain everything on the ground is sheltering them. They can be found in dead pine stumps and fallen trees, but only under the bark and the surface of the wood, when it decays, and the sawmillers sometimes find them in pipes in old and over-matured trees. Nearly all the original homes of the western pioneers, both on the stations, and in the townships, were built of Cypress pine, and in many still remaining after a lapse of sixty years or more the timber, unmarked with dry rot, or white ants, is as sound as the day it was placed in position.

In Narrabri I was shown an office where the white ants had come up from the floor and eaten out the official records, closely packed in Cypress pine shelving, but when the clay and remains of the records were removed, there was not the mark of a termites tooth upon the surface of the wood.

Like all our Australian trees, the pines have their own special inquilines and parasites, but most of them are confined to the pine foliage, and do no serious damage to the timber. In my "Forest Insects of Australia" these pests were briefly dealt with.

Two beetle borers belonging to the family *Buprestidae* damage the timber of injured or dead trees, the large *Diadoxus scalaris* is rare in New South Wales as far as my experience goes, the smaller and somewhat similar looking species described in this paper doing most of the damage.

Diadoxus erythrura.

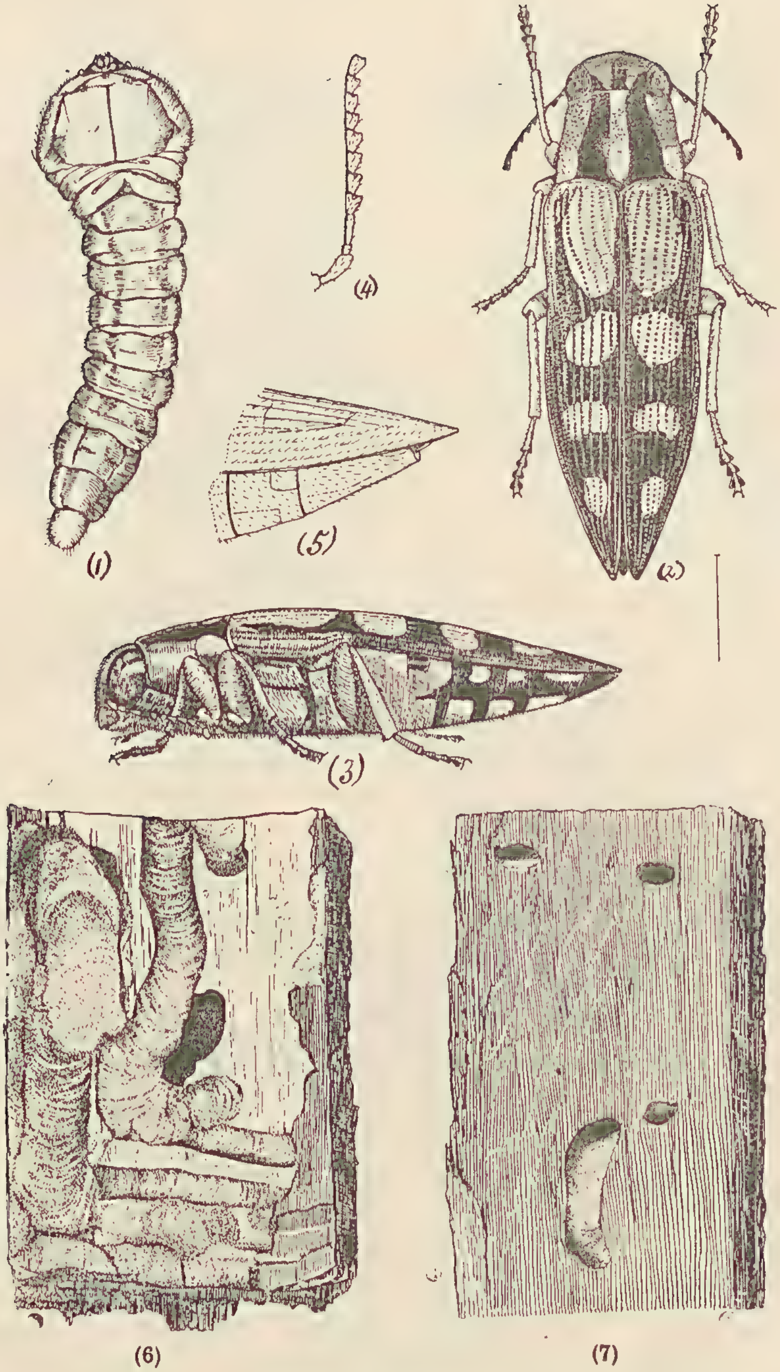
The adult beetles emerge from the trunks of dead trees or felled logs, cutting a clear hole through the outer surface of the dry bark, in the early part of December. In a large log under observation starting from this date they continued to emerge until the end of January. Their life cycle in the wood is evidently about twelve months, though as is often the case with wood borers, there are generally some belated larvæ that remain in their bores the following season.

The beetles lay their eggs in the surface of the bark; the tiny larvæ soon cut their way to the inner surface. It is on this inner portion of the bark that the growing larvæ feed; for until the nearly full-fed larvæ cut their way into the sapwood they simply mark the outer surface with a slight scroll-like pattern while gnawing the closely attached bark. Thus the bark of an infested tree has the whole of its inner portion gnawed in wavy galleries which are firmly packed with wood dust. It frequently has quite a variegated pattern, where the brown bark dust and the outer yellow wood dust are packed in flattened galleries running side by side.

In the earlier stages of their development a very large percentage of these little larvæ are destroyed; particularly when infesting felled logs, stacked in the mill yards. This appears to be caused by the moisture generated in the decaying bark which produces fungus or mould spores that infect the beetle larvæ. There are also a number of beetle predators and wasp parasites that destroy them while under the bark. I obtained among others a number of dull red larvæ of some undetermined cleridæ beetle. When full fed, the full-grown round-headed larvæ cut their narrow oval burrows into the sapwood of the pine. In most cases these burrows are not over an inch in depth, and are frequently much shallower. These are not closely packed with wood dust, and are often quite open under the bark. They pupate at the end of the burrow.

In a number of pine trees cut in the Forbes district the butts of the logs are thickly marked right up to the centre with large elongate oval bores. These bores are so closely packed with wood dust that when the logs are cut up on the saw bench it remains intact, and a sawmiller told me it can be even planed and varnished without breaking out.

PLATE IX.



Cypress Pine Beetle.

Diadoxus erythrura.

1. Larva of *Diadoxus erythrura.*
2. Beetle, showing dorsal view.
3. Beetle, showing side view.
4. *Antennæ* of beetle (enlarged).
5. Tip of abdomen of beetle (enlarged).
6. Section of cypress pine showing damage.
7. Under-surface of bark covering this wood.

These sealed bores sometimes extend for 12 feet or more up a log; and though I removed the bark on a number, I could find no exit holes where the beetles responsible for the bores had emerged. The timber-getters say that this interior damage is caused by *Diadoxus erythrura,* but I think they are mistaken, because the bores are so much larger and extend right into the heart of the tree. It appears to me that some other buprestid or longicorn larvæ attacked the trees at an early stage of their growth, when the trees had suffered from some external injury, such as caused by a forest fire, and then recovered, and that the subsequent years of added growth have so consolidated the wood dust that it has been almost incorporated in the surrounding wood tissue.

As far as I could learn, none of the cutters or bench-men have ever found any living insects, or even insect remains in these solidified galleries. Further investigation, however, is required to settle this question.

As the admirable plate drawn by Miss King illustrates the whole life history of the Cypress pine beetle, there is no need to enlarge upon the form or structure of the larva or pupa. The former is a typical "Round-headed borer, flattened in form, with the three thoracic segments swelling out behind the head, and the following abdominal segments contracted, distinctly segmented, and rounded at the tip.

The handsome little beetles are very active creatures. As soon as they extract themselves from the pupal chambers they fly about in the sunshine. They vary slightly in size from ½ to ¾ of an inch. Though brightly-tinted with brown and yellow, they have a distinctly greenish colour. The mouth parts are yellow, the antennæ black and the eyes dark brown. The under surface of the thorax, legs and front of the head are green, with this colour coming round the edges of the prothorax, and shading into the first pair of yellow blotches on the wing covers. The dorsal surface of the prothorax and wing covers is dark reddish-brown, sometimes clouded with black; the centre and sides of the prothorax striped with bright yellow. The wing covers are ornamented with four irregular yellow blotches down each side and the third pair daintily shot with red in the outer edge. The under surface of the body is reddish-brown, marked with four rows of yellow spots.

This beetle was originally described and figured by Adam White of the British Museum when studying the entomological collection sent to England by Captain Stokes. He gave the locality of the type specimen as Swan River, New Holland.

In 1868 Saunders, in a paper dealing with Australian *Buprestidae,* published in the Transactions of the Entomological Society of London, illustrated it with a diagrammatical drawing of the dorsal markings of this beetle.

The first published record of its life history is in a report by a visiting naturalist (Baron von Lendenfeld) to the New South Wales Government in 1885. French, in the fifth part of his "Destructive Insects of Victoria, 1911," figured it and the larger species (*Diadoxus scalaris*) in a coloured plate.

He called attention to the fact that these beetles often deserted their native host tree to infest the introduced popular hedge Cypress (*Cupressus lambertiana*). This is so well known now that this hedge is seldom planted in country where our Cypress pines grow.

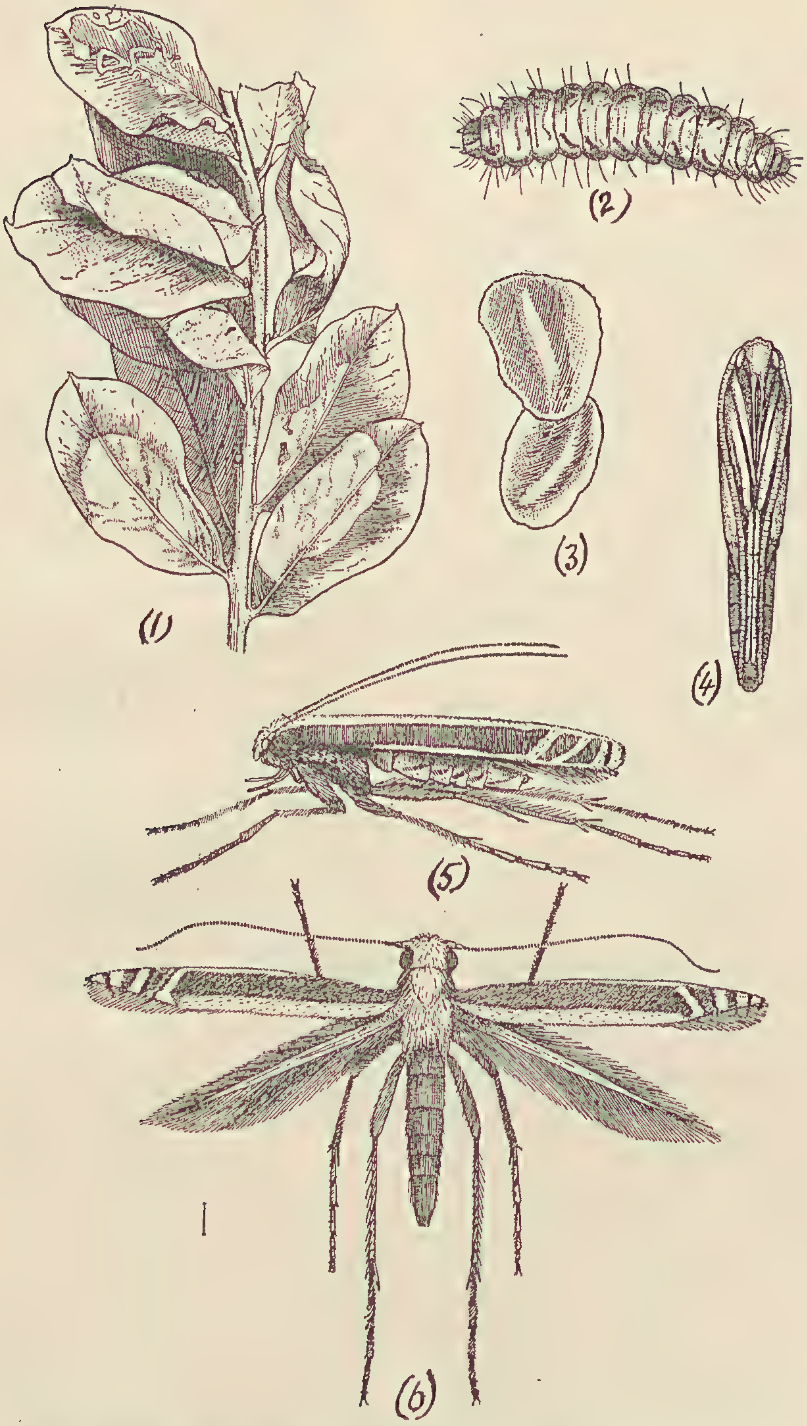
THE LEAF-MINING MOTH OF THE QUEENSLAND SILVER WATTLE.

(*Acrocercops plebia,* Turner.)

One of our most attractive flowering wattles is the Queensland wattle (*Acacia podalyriaefolia*). It has been planted extensively in New South Wales and Victoria during recent years, for it has an early flowering habit and richly-coloured delicate bloom.

In Queensland it is known as the Silver or Mount Morgan wattle. It may become an even more cosmopolitan species than its garden rival, the Cootamundra wattle (*Acacia baileyana*), because it is proving itself more adaptable to its surroundings and will thrive in all soils, and in varied situations. It will even hold its own in the poor Hawkesbury sandstone soil, whereas the Cootamundra wattle does not flourish in such ground. During the last few years, however, this favourite wattle has had a

PLATE X.



Leaf-mining Caterpillar of *Acrocercops plebia,* Turner.

Attacking the foliage of the Queensland Silver Wattle (*Acacia podalyriaefolia*).

1. Foliage of *Acacia podalyriaefolia* damaged by moth larvæ.
2. Caterpillar of *Acrocercops plebia.*
3. Cocoons or pupal sacs of moth.
4. Pupa removed from cocoon.
5. Lateral view of the moth.
6. Moth viewed from above.

[*Drawn by* Miss King.]

serious setback, as the foliage of the Queensland wattle has been badly damaged by the leaf-mining larva of a small moth The larvæ cause the leaves to be covered with unsightly blotches, where they are feeding beneath the epidermis, and when badly infested the bushes are almost defoliated.

This leaf-mining pest was first brought under my notice some two years ago, but all the leaf samples examined were simply untenanted empty blisters; there were no larvæ or pupæ enclosed to indicate the particular insect responsible for the damage. When visiting Wentworth House at Vaucluse in the early part of last January, I noticed a clump of small Queensland wattles looking in a very ragged, unhealthy condition. All the lower leaves were variegated with large brown blisters, occupying nearly half the leaf. Most of them were empty, showing where the caterpillars had been feeding beneath the epidermis; and there was a small opening in each, showing where the full-fed imprisoned larva had cut its way out. On the more recently infested foliage above, each browned area contained an active elongate green or pinkish-tinted caterpillar feeding on the inner substance of the leaf.

A quantity of these damaged leaves were brought home, and placed under observation in the breeding cages in the insectarium (5/1/1925). The following week all the caterpillars had made their way out of the blistered leaves, and they had spun, or rather constructed, irregularly rounded, convex, light brown, scale-like cocoons attached to the sheets of paper in the tins.

The larvæ very much in colour, ranging from semi-transparent and rich green to deep pink. They measure about ⅛ of an inch in length, and are slender in proportion. The head is lobed, of a dull yellow colour, with a dark line bisecting it down the centre, with another line round the margin of the head. The three thoracic and first six abdominal segments are of a uniform size, with the last three abdominal segments smaller and tapering to the apex. The legs are yellow, and the dorsal surface of the segments of the body variegated with tiny yellow dots; the whole lightly clothed with scattered hairs.

The pupal case, or scale-like cocoon, is formed of a dull brown parchment-like material, so thin and semi-transparent that the outline of the enclosed pupa can be easily made out; general form broadly oval. On an average it measures ¼ inch across the centre.

The pupa, slender and cylindrical, measures about ⅛ of an inch. The cephalic portion is furnished with a small boss, or projection in front. At first the pupa assumes a pinkish tint, changing into a uniform yellow colour as it matures. It has the habit of twitching the tip of the abdomen when the cocoon is handled.

The active little moths were swarming in the breeding jars (to which the pupæ had been removed) about a fortnight after the larvæ had pupated. They are dainty little silver-grey coloured moths, with a broad parallel dorsal stripe of silvery-white scales down the inner portion of each fore wing, with four short cross bars of the same colour at the tips, giving them a very distinctive character. They measure slightly over 1/10 of an inch in length.

This species was originally described by Dr. Turner under the name of *Gracilaria plebia*, in a paper entitled "Descriptions of Mico-lepidoptera from Moreton Bay," published in the *Transactions of the Royal Society of South Australia* in 1894. In this paper he described twenty new species from the vicinity of Brisbane. When specimens of the bred moths were forwarded to Dr. Turner, he identified it as a member of the family *Gracilariadae,* and the one which he had described and named *Acrocercops plebia* over thirty years ago.

He wrote: "I described it in 1894, and have eight or nine examples, all chance captures, so it is not uncommon in Brisbane. It is not known to have occurred previously in Sydney, and though negative evidence is always incomplete, we must remember that Meyrick searched diligently for species of this genus in the 'eighties. I conjecture that some lady travelling from Brisbane to Sydney took with her a bunch of golden wattle bloom of *Acacia podalyriaefolia,* and with it unwittingly introduced some leaves mined by this moth. The remedy would be to introduce such mined leaves on a large scale (from Queensland), for some would certainly be parasitised."

I think Dr. Turner's suggestion is quite practical, and could be very easily carried

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out by the co-operation of the Entomological branches of the two Departments of Agriculture in Brisbane and Sydney.

Many of the members of the family *Gracilariadae* are leaf miners, a European member of the family *Gracilaria syringella* Lim. A delicate, pale grey moth, about half an inch across the outspread wings, is not uncommon in English gardens, where its larvæ form similar blotches on the leaves of the lilac and privet.

Since looking into the matter, I find that the damage caused by this moth is widespread in New South Wales, and Mr. French informs me that the blistered leaves are well known in Melbourne gardens.

Note.—Dr. Turner has recently published in a note (on the information I sent him) in the *Queensland Agriculture Journal,* June 1925, accompanied by a figure of the moth.

THE ISLAND PIN-HOLE BORER.

(*Xyleborus perforans,* Wolliston.)

This tiny pin-hole beetle is the commonest species in the kauri and kiolo logs that are sent from the Solomon Islands to Sydney. I have also had specimens taken from the stem of a dying coconut palm. Other specimens have been found in Red Lauan logs coming from Borneo, and it also has a wide range over the Philippines and is common in India.

It was originally described by T. V. Wolliston in his "Catalogue of the Coleopterous insect of Madeira in the collections of the British Museum," published in 1857, under the name of *Tomicus perforans.* The describer writes: "Inhabits the wine stores of Funchal, feeding on the bungs of the casks. It was first pointed out to me by Mrs. Phelps during the summer of 1855, who stated that it was at times exceedingly troublesome; procuring for me a cork which had been completely destroyed by it."

In 1893 W. T. H. Blandford published a bulletin entitled, "A report of the destruction of beer casks in India by the attacks of a boring beetle (*Xyleborus perforans*)." In this report he describes the final identification of the borer, and records many instances of casks and their contents being damaged in India by this beetle. In one case 134,000 perforations were estimated to occur on the outside of a beer cask. Many suggestions were made to stop the infestation, or to kill the borers before they perforated the casks. Dipping the casks in a vat of boiling water or painting the outside with cresote or oil were recommended.

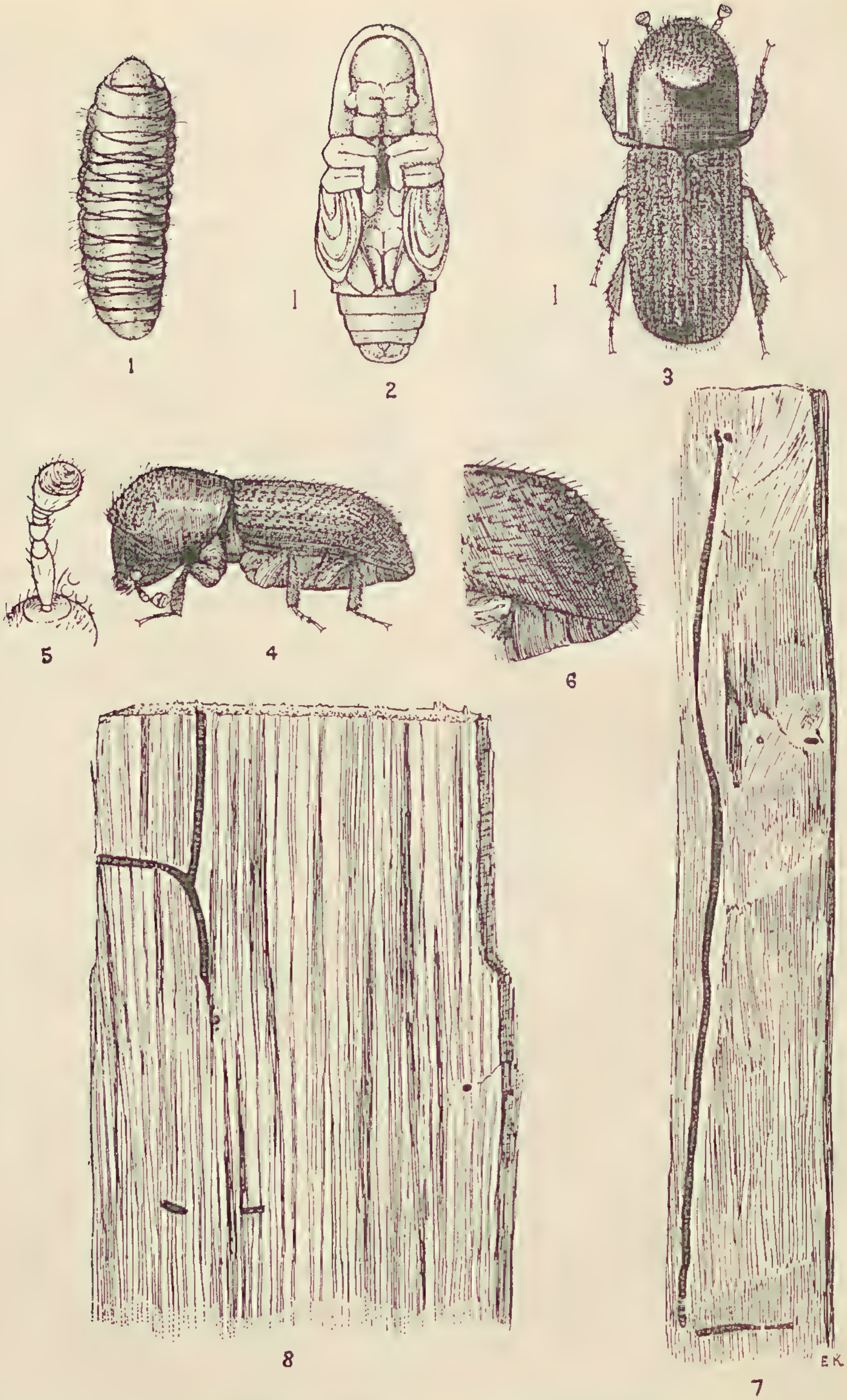
The members of the genus *Xyleborus* are among the most serious pin-hole borers that attack the surface of the timber, when exported in the log from the Pacific Islands. They are also common in the coastal forests of Australia, where they infest freshly-felled logs as soon as they are barked. As long as the timber remains in a moist and sappy condition they work in the log and continue their vertical tunnels. In a neglected log they often reach the centre, and the whole of the timber in the log is pin-holed and becomes second-rate timber.

I have usually found them in pairs when excavating the long parallel galleries, and in the end of some of the tunnels find the active larva. The breeding galleries of these little borers show no uniformity of design, but run at all angles and are irregular in length and direction. The surface timber is generally much more closely covered with pin-holes than the heart wood, but this is probably due to the fact that numbers of them are destroyed before they get beyond the zone of the outer wood of the log by exposure or predatory parasites.

The specimens from which the description and drawings are made were collected from a shipment of logs of kauri and kiolo cut on Vani Koru Island, of the Santa Cruz group, Solomon Islands, which arrived in Sydney last April. In both kinds of timber logs the whole of the surface was closely perforated with pin-holes, many of them showing the wood dust, below which the active beetles were working. Both beetles and larvae were exposed in numbers when samples were chopped out of the logs.

When the outer portion of the logs cut off in the timber yards were split up in the insectarium, in the early part of May, numbers of the active little beetles were collected, and those left in the sections of timber continued their tunnels for some weeks. The semi-transparent larvae were met with in many of the tunnels, and often at the extreme end of the parallel bores.

PLATE XI.



Xyleborus perforans, Vera Cruze, Solomons.

(1) Larva of *Xyleborus perforans.*
(2) Pupa of *Xyleborns perforans.*
(3) Beetle. Dorsal view.
(4) Beetle. Lateral view.
(5) Antennæ of beetle.
(6) Apex portion of wing covers of beetle.
(7–8) Sections of Arancaria pine timber showing tunnels made by the beetles.

[*Drawn by* Miss King.]

The transverse galleries, as shown in Figs. 7 and 8 of the plate, were formed about 8 inches from the outer surface of the log. The main gallery contained two active beetles and eleven larvae exposed when the wood was split.

These logs on arrival in Sydney were in a very sappy condition, and the importers said they had been felled and cut up some months before and submerged in the river for some time before shipment.

All logs felled, barked, and cut up in the tropical forests are almost immediately attacked by *Xyleborus* and *Platypus* beetles. It would certainly pay the timber-getters to paint or spray all logs, even if they are shipped immediately after cutting, with some oily cresote mixture, for the active beetles fly about in the twilight and are abundant, particularly in the early summer about the mills and timber ramps.

Life History.—The somewhat elongate, oval, white larva measures about one-eighth of an inch in length. The jaws and mouth parts brownish yellow, with no distinctive markings on the head or thoracic segments. The head is small and somewhat globular; the thoracic and abdominal segments well defined, rounded on the outer margins and fringed with fine hairs. They are very active little legless maggots, wriggling about when removed from the gallery and placed on a smooth surface. The pupa is shorter and more thickset, measuring about one-tenth of an inch, with the cephalic portion rounded and smooth to the abdominal segment. Each of the abdominal segments furnished with a single short hair; the legs and wing covers folded on the sides, the tips of the latter reaching to the margin of the sixth abdominal segment.

The adult bettles vary much in colour, from very pale yellow to light-brown according to their age. The eyes and jaws are black; the whole beetle lightly clothed with fine brownish-tinted hairs. Viewed from above the head is completely hidden by the overhanging prothorax; which is truncate behind, closely covered with shallow punctures, and is about one-third of the length of the whole insect. The wing covers finely and closely punctured, truncate in front, rounded on the sides and slightly truncated on the tips, which are ornamented with short blunt spines. Length about one-tenth of an inch.

In captivity the beetles feed upon the moist wood until the sap, forming a sticky congealed mass, fills the galleries and exudes out of the surface of the wood. As the wood gradually dries the beetles crawl out of the bores and die in the bottom of the tins.

In dealing with infested logs coming into Australian ports, the danger of these beetles escaping from the pin-holed logs and establishing themselves in our forests has been carefully considered. Under existing regulations, when all the sapwood is cut off and burnt under quarantine supervision in the sawmills, all the sawn timber dries so quickly that the enclosed beetles die in the burrows.

SHOT-HOLE BORERS OF THE FAMILY BOSTRYCHIDÆ.

In dealing with introduced timber-borers belonging to this family in No. 4 of this series, the writer gave an account of *Sinoxylon anale*, a species with a wide distribution all over the East, and even recorded from the Northern Territory of Australia. In this article, that account is supplemented with a drawing of the beetle, and its distinctive antennæ, by which it can be easily identified. Among the typical Australian species of Bostrychidæ (the larger species of which are also known as " auger beetles," on account of the clean-cut hole they make when entering the bark and sapwood), the writer gives the life history and range of two of the commonest and most widely distributed species.

(1) The Parti-coloured Bostrychid.

(*Xylion collaris,* Erichson.)

In a series of articles on the life histories of Australian beetles, contributed to the Proceedings of the Linnean Society of New South Wales, 1894, the writer described the work of this beetle. The specimens under observation had riddled the stem of a dead gum tree (*Eucalyptus hæmastoma*) near Hornsby, New South Wales. In this paper I said: " The larva feeds upon the dead wood of various species of gum trees, chiefly in the sapwood. This it completely riddles with irregular parallel channels, which often cross and run into each other, and are all filled behind as the larva moves along. When full grown it pupates in an oval chamber at the end of the last bore."

The writer's recent investigations have added further facts regarding the life history of this active little borer.

The adult beetles may be found all the year round in our more northern forests, but are much more active and numerous in the summer months, particularly in the spotted gum forests of the South Coast. From early in October to the end of the summer, almost as soon as a smooth-barked gum tree is felled in the forest, these beetles may be found on the surface of the bark, where they immediately set to work to cut their circular shafts through the bark into the sapwood. When the sapwood is reached in a green log their lateral galleries are somewhat irregular, but in drier timber they have the habit of excavating long, lateral galleries just beneath the bark in the outer surface of the sapwood, as shown in the illustration.

When the felled logs are drawn into the sawmill yard exposed to the heat of the sun, and the bark dries on the log with parallel cracks, many beetles die without finishing their work. The writer found many of the adult beetles dead in their vertical shafts, both in the bark and surface of the sapwood, in the middle of January, when collecting in Bateman's Bay and Moruya districts.

This beetle has a wide range—from Tasmania, Victoria, and South Australia, through our coastal forests, well up the coast of Queensland. I have cut it out of the stems of the spotted gum (*Eucalyptus maculata*) in many localities, also from the coastal blue gum (*Eucalyptus saligna*) at Dorrigo. At Narrabri I found them boring in the stems of some dying South Australian golden wattle (*Acacia pycnantha*). It was originally described from Tasmania by Erichson under the name of *Apate collaris* (Weightman's Archives, 1842). Lea, in a paper in the Proceedings of the Linnean Society of New South Wales, 1893, redescribed the male and female beetles under the names of *Apate excavata* and *Apate bicolor;* but in a footnote adds that since writing the descriptions he had proved that the latter was the female of *Apate excavata.* It was Lesne who transferred this beetle to the genus *Xylion* when revising the Family *Bostrychidæ* in the Annals of the Societe Entomologique de France in 1891.

This beetle measures about ¼ inch, and, unlike many species of the family, seldom varies much in size. The general colour varies from dark reddish-brown to almost black, the legs and under-surface lighter yellowish-brown, the prothorax yellow. In live specimens the contrast between the yellow colour of the prothoracic segment, above the head, and the dark-brown wing covers is very marked, but in dead museum specimens the yellow tint usually becomes with age much darker. The front of the prothorax is very finely roughened, with longer spines on the sides, the hind portion smooth and shining. Viewed from above, the enfolding wing covers give these beetles a regular cylindrical form, but the undersurface is contracted and rather convex. These wing covers are very finely shagreened. The form of the tips of the wing covers vary in the sexes. In the male beetle they are finely punctured, curved sharply down with a pair of blunt spines on either side of the rounded disc, and the extreme tips produced into a blunt projection, slightly turned upward. In the female the spinal projections round the anal disc are smaller, only projecting slightly above the margin, and the tips of the wing covers fitting close together.

(2) The Cylindrical Bostrychus.

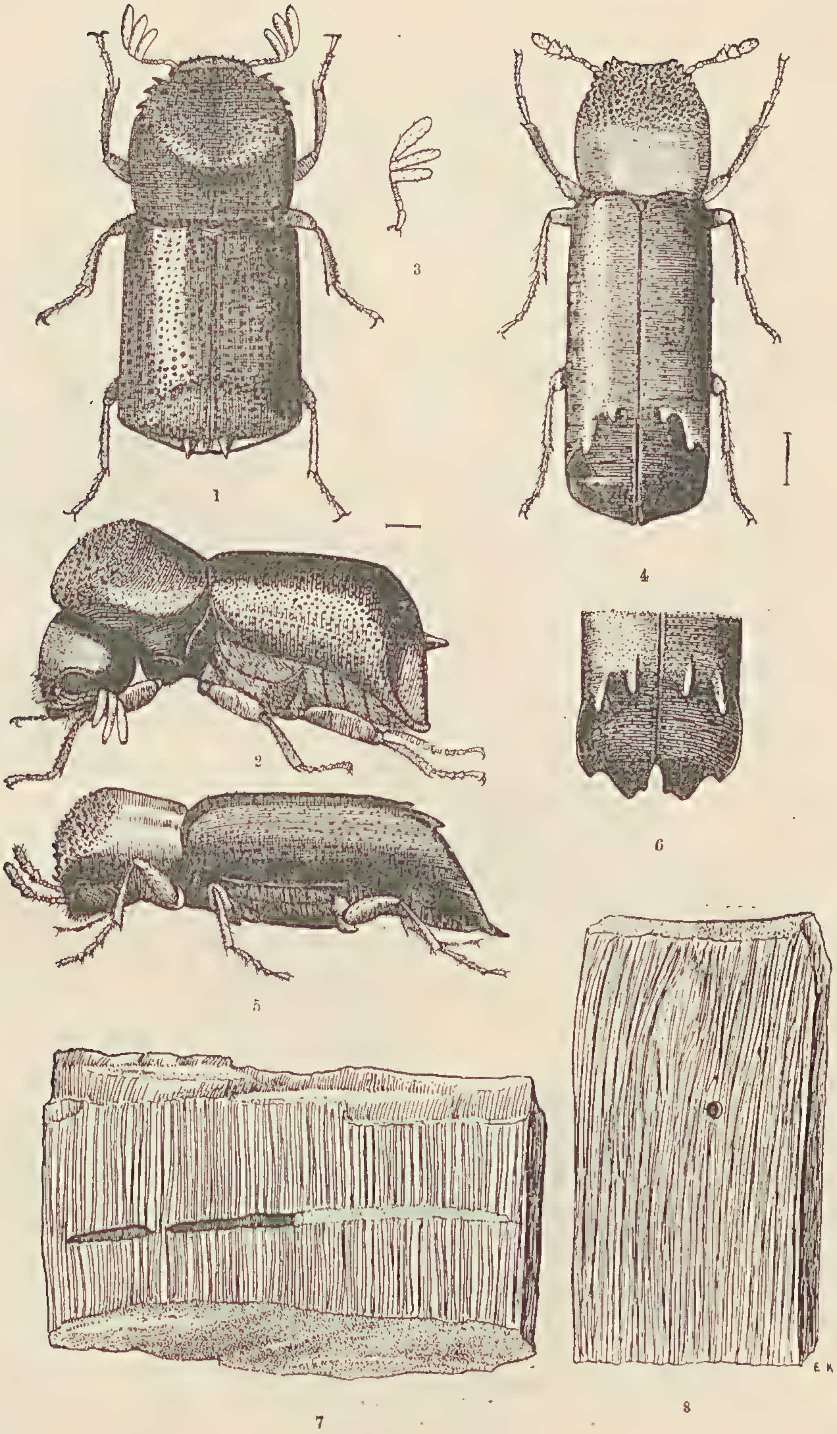
(*Xylion cylindricus,* Macleay.)

The original description of this widely distributed borer will be found in Macleay's paper, "Beetles of Gayndah," published in the Transactions of the Entomological Society of New South Wales in 1873. He called it *Bostrychus cylindricus,* and it is often found in collections under this name, though Lesne transferred it to the genus *Xylion* when revising the family in 1898.

In 1903 I contributed a paper to the *Agricultural Gazette of New South Wales* entitled "Some Wood Boring Beetles and their Habits." In the article, this beetle was recorded damaging empty wine casks by boring holes right through the staves and causing them to leak when refilled. These injured casks had been left outside a wine cellar for some time, in an orchard near Sydney. The paper is illustrated with a drawing of the beetle which is reproduced in "Australian Insects."

During the last two years, when collecting timber borers from fallen timber and felled logs, I have never found this species as numerous as several of the smaller ones, but it is

PLATE XII.



Forest Insects.

(1) *Synoxylon anale.* Dorsal view.
(2) ,, Side view.
(3) ,, Antennæ.
(4) *Xylion collaris.* Dorsal view (male).
(5) ,, Side view (male).
(6) *Xylion cylindricus.* Showing apex of wing covers of female.
(7) Showing vertical bore of *Xylion collaris* through the bark.
(8) Showing lateral gallery of *Xylion collaris* in the sapwood beneath the bark

fairly common, and has a very wide range over Australia. In New South Wales I have taken specimens in red gum (*Eucalyptus rostrata*) at Hay, in the Dorrigo forest found it boring into blue gum (*Eucalyptus saligna*), and on the South Coast forests in the felled logs of spotted gum (*Eucalyptus maculata*). It sometimes infests orchard trees; last season Mrs. W. L. Wearne gave me several, cut out of a cultivated fig in a Sydney garden. The Queensland Museum contains specimens from Brisbane, Mackay, Cairns, and Charters Towers. The National Museum in Melbourne has this beetle from various parts of Victoria, and others collected by Professor Spencer from Melville Island and Roper's Creek, Northern Territory. Lea records it from Tasmania; and I have several from South Australia.

The damage, known as "pinholing," in our hardwood timbers is the result of the presence of these and several allied species of the family. Though unsightly in the sawn timber a few pinholes make no difference in the structural strength of the dressed timber, because there is no life left, the beetles leaving the wood as soon as it begins to dry.

The time of infestation, when the damage is done, is between the time the tree is felled, drawn into the mill yard, and cut up on the saw bench. In most cases if the felled logs were barked at once the summer sun would put a dry surface on the log, which would greatly reduce the pinholing.

THE GREAT PINE WEEVIL.

(*Eurhamphus fasciculatus*, Shuchard.)

THE life history of this remarkable weevil has, as far as I know, never been previously placed on record, though I believe my valued correspondent, Mr. R. Illidge, who had done so much original investigation regarding the life histories of the timber-boring beetles of southern Queensland, has been acquainted with its range and habits.

In my "Forest Insects of Australia," I gave a general description of the adult beetle, and its bibliography, but at the time of writing had never seen the living beetle under natural conditions.

It was originally described by Shuchard in 1838, in the fifth volume of the "Entomological Magazine," illustrated with a fine figure of the beetle. Somehow, Shuchard's localities were at fault, for he stated that the specimen he was describing came from New Zealand, and that he had seen a second specimen in the Curtis collection from Van Dieman's Land. Masters corrected this in his "Catalogue of Australian Coleoptera," and recorded the habitat as New South Wales and Queensland.

The range probably extends over the whole of the area in which the hoop pine *Araucaria Cunninghami* and *A. Bidwilli* grow in both these States.

Since I commenced my field observations upon the insects of the hoop pine in the Dorrigo forest areas, I have worked out the life history of this fine beetle, which, as will be seen from the accompanying drawing by Miss King, is one of the most striking looking curculonid beetles in Australia. It is really entitled to a coloured plate, to show the beauty and colouration of the hairs and scales decorating its body.

During a visit to Brooklana in the middle of December, 1923, when investigating the stump of a large hoop pine which had been snapped off some few feet from the ground in a windstorm the previous year, Mr. Saladine and I found a large circular hole in the side of the trunk about 3 feet from the ground. It was a parallel bore, over ½ inch in diameter, loosely plugged with torn strips of pine wood, beneath the decaying bark. On carefully cutting out the section and splitting it open the large oval cavity was revealed, in which we found the perfect pupa. It had a general bluish tint, and was resting in an upright position on the tip of its abdomen, folded up in its swaddling clothes, its large eyes standing out on either side of the head, with the long snout, antennæ, and legs folded down the centre of its breast, and the semi-transparent wings folded round the body. It reminded one of a grotesque Japanese doll, in its mummy-like wrappings. Carefully packed in a tin the specimen was brought down to the Forestry Laboratory in Sydney, but when the package was opened out a few days later it was found that the pupa had undergone its final metamorphosis, and became a perfect beetle, with the pupal skin, like a cast-off jacket, in the bottom of the cavity. As we have since been unable to find a second pupa, we have not been able to figure this stage of the beetle's development in our plate.

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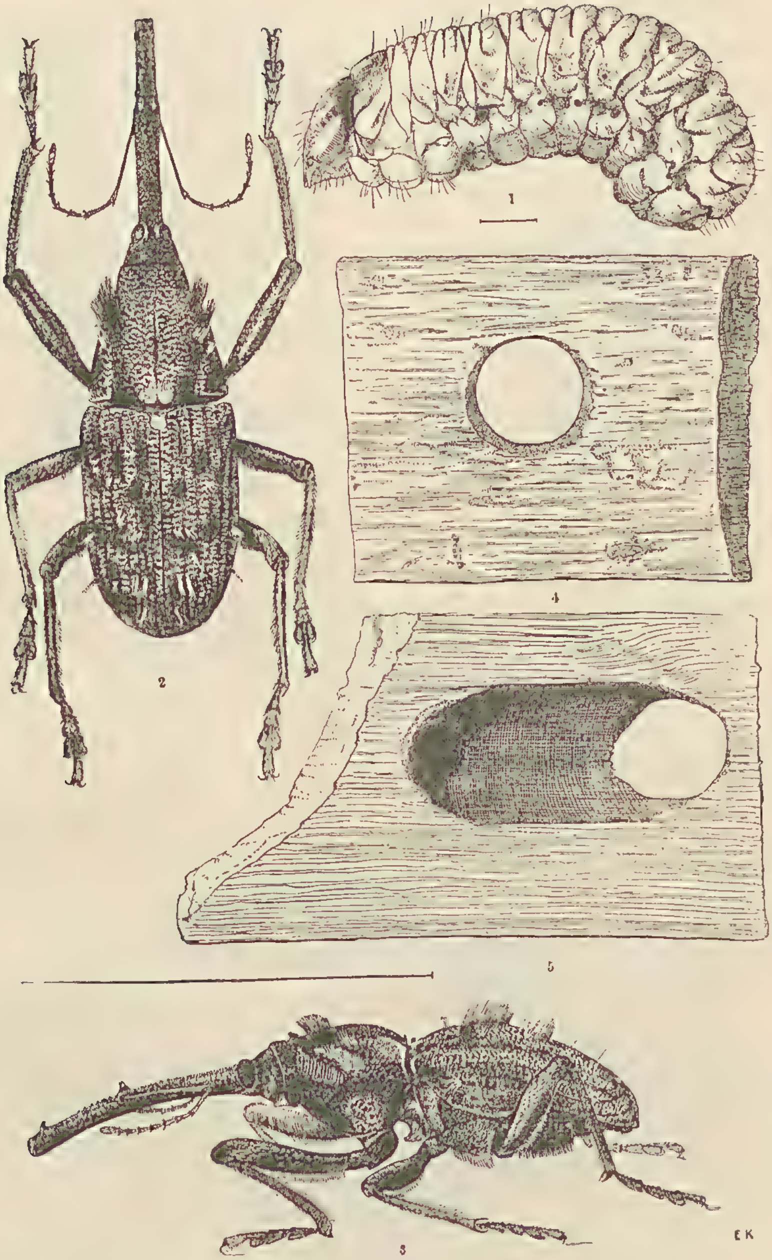
PLATE XIII.



The Great Pine Weevil.

Eurhamphus fasciculatus, Shuchard.

1. Larva of *Eurhamphus fasciculatus*.
2. Beetle viewed from above.
3. Beetle showing side view.
4. Opening in pine stem made by larva.
5. Cavity behind opening in which the larva pupates.

In the following season, when cutting into a dead pine tree standing on the edge of the forest and still retaining its stout bark, I obtained several half-grown larvæ behind circular openings into the dead wood.

I have not found any of these larvæ in the remains of the trees felled by the timber cutters in the forest, though when the bark is stripped off there are scores of longicorn larvæ feeding in the under portion of the decaying bark and surface wood. It is evident that this weevil prefers the stems of dead or dying pine trees in the forest to those of felled trees resting on the ground. One of the most remarkable facts in the life history of this beetle is the very flimsy protection used to close up the outer surface of the cavity in which the beetle pupates. Without the protection of the bark, these pupæ can be very easily found by predatory beetle larvæ and other parasites, and even under the bark many parasites are always hunting.

Mr. Illidge suggested that this beetle is rare because the large carnivorous larva of the giant click beetle (*Alaus prosectus*) hunts them out. Under the bark on the trunks and branches of the felled pine logs left in the forest these larvæ are very common, feeding upon the various longicorn and weevil larvæ which swarm in the decaying wood. Therefore, the more felled logs left in the forest, the more carnivorous larvæ, and under the altered forest conditions the more rare this fine beetle may become.

The following description of the beetle is taken from bred specimens, with all the scales and tufts of hairs unruffled and undamaged.

The beetle measures 2½ inches from the tip of the snout to the apex of the wing covers, and is over half an inch across the middle of the back. The ground colour of the beetle is black, but the legs, snout, and antennæ are clothed with fine white scale-like hairs, those upon the inner surface of the tibiæ and tarsi long silky hairs.

The upper surface of the prothorax and wing covers covered with tiny patches of white hair-like scales, interspersed with irregular parallel bands of reddish-brown hair-like scales. On either side, about the middle of the prothorax, the scales are elongated into a big tuft of darker reddish-brown hairs; on each wing cover there are three similar but smaller tufts of hairs, while the wing covers are further decorated with some smaller tufts of white hairs about fourteen in number. The under-surface of the head and prothorax is smooth and shining, closely and finely marked with transverse lines (*striæ.*) The under surface of the body lightly clothed with white scales.

THE PREDATORY LARVÆ OF CLICK BEETLES.

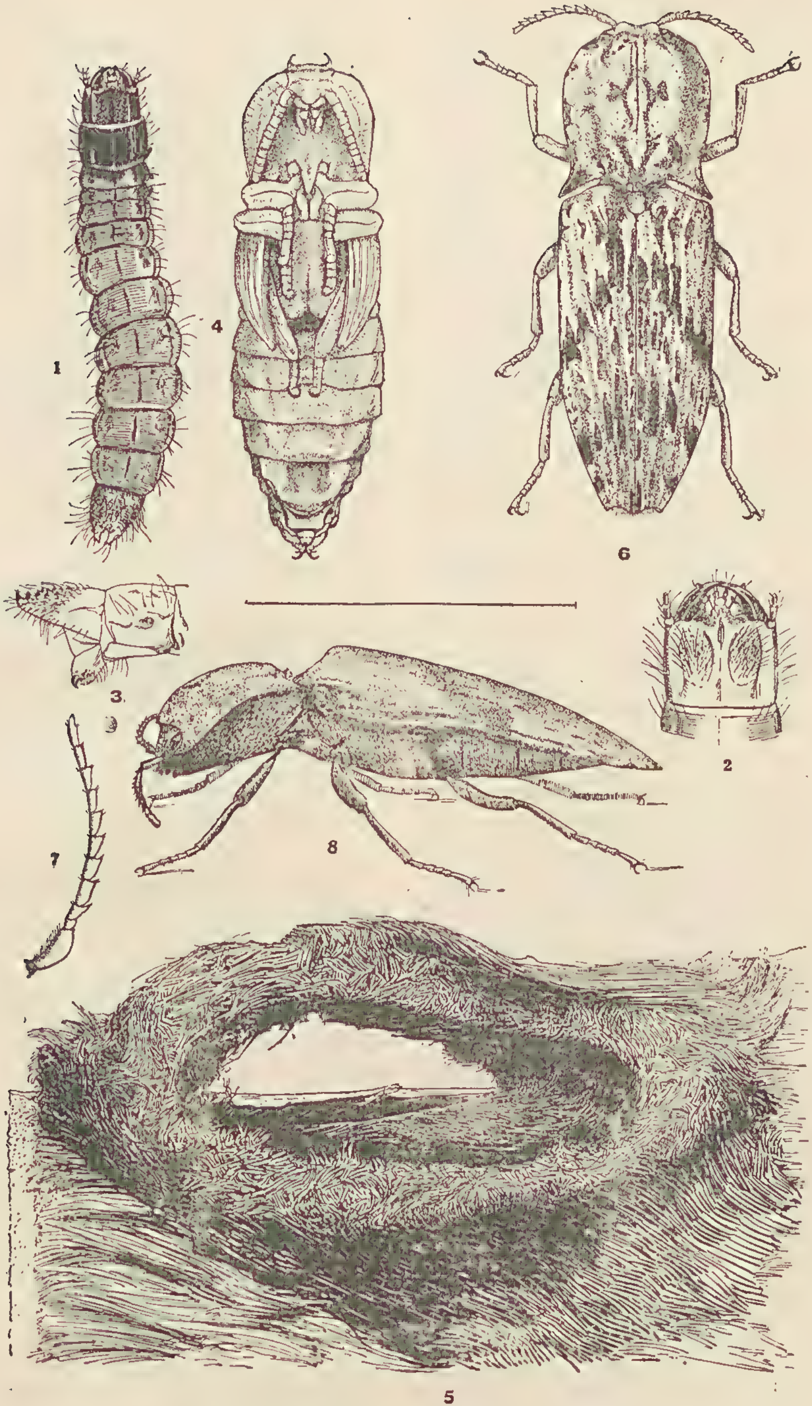
(*Family Elateridae*) *Alaus prosectus*, Candeze.

The slender boat-shaped beetles belonging to the Family *Elateridae* are furnished with a prolongation of the under portion of the prothorax, which, with the flattened form of the hind margin, enable them, when they fall on their backs, to bend the prothoracic section, and the rest of the body upward, and then contracting spring upward to a considerable height from any smooth surface.

From this distinctive habit, adopted so that they can turn over and regain their feet, they are known by the popular and rather appropriate name of "Skipjack Beetles," and their second popular name of "Click Beetles" is also very suitable, as it refers to the sound, a sharp click, made by the contact of the two portions of the prothorax and wing covers, when they execute the upward spring.

Most of the larvæ of the smaller species are known as "wire worms" on account of their hard integument and slender cylindrical form, and, when numerous, many foreign species are known to do considerable damage to the roots of grass and plants. The larvæ of some of the large forms, however, are very curious-looking creatures, and that of a western species (*Tetralobus fortnumi*), figured by me in the *Agricultural Journal* of New South Wales, 1917, is unique in form, and is probably carnivorous. The larvæ of the large grey and brown "Click Beetle" belonging to the genus *Alaus* have long been known as active predators on the larvæ of the larger timber-boring longicorns of New South Wales and Queensland, though very little has been recorded about their structure, or life history.

PLATE XIV.



Life History of Great Click Beetle.

Alaus prosectus, Candeze.

1. Larva of *Alaus prosectus*.
2. Head of larva.
3. Anal segment of larva.
4. Pupa of *Alaus prosectus*.
5. Pupal chamber, under dead pine bark.
6. Dorsal view of *Alaus prosectus*.
7. Antennæ ,, ,, ,, ,,
8. Lateral view of *Alaus macleayi*.

Mr. R. Illidge, of Brisbane, informs me that the larvæ of *Alaus gigas* is an active enemy of the great longicorn beetle *Batocera boisduvali,* whose larvæ feeds in the stems of various native fig trees in Queensland. *Alaus sericus* infests the stems of the poison mangrove, where its larvæ is a predator upon the spine-shouldered longicorns (*Monohammus* sp.). He has taken larvæ of *Alaus macleayi* from the decaying stems of *Tristania, and Eugenia~~s~~,* where they feed upon various Prunid longicorn larvæ. Regarding *Alaus mixtus,* he finds the larvæ common in the decaying branches of the mangroves damaged by the larvæ of the large brown Prunid longicorn (*Agrianome gemella*), a longicorn which now also infests the timber of many introduced garden and orchard trees and great numbers of softwooded scrub trees.

The larvæ of the handsome Click Beetle (*Alaus prosectus*), figured and described in this paper, confines its attention to the timber boring larvæ of weevil and longicorn larvæ found beneath the rotting bark of felled or dead Hoop pines (*Araucaria* sp.) in northern New South Wales and Queensland. It is therefore quite evident, from the long-continued field observations of this well-known entomologist, and my own investigation, that all the known larvæ of the members of the genus *Alaus* are useful predatory creatures, which must play a very important part in the control of the many timber-boring beetles while in the larval and pupal stages.

Early in the season, when stripping off the decaying bark on the felled or fallen dead Hoop pine (*Araucaria Cunninghami*) in the Dorrigo forest one will expose large numbers of the elongate white larvæ of the marbled grey longicorn (*Diotoma undulata*), these larvæ feeding upon the soft under portion of the decaying bark until they are full fed, before they cut their way into the pine wood beneath, in which they construct their pupal chambers. Scattered about among them will also be found various other larvæ, among them a large savage-looking active creature with powerful curved mandibles, with which he can seize and hang on to anything placed in front of him. In the Dorrigo forests these larvæ find the supply of the helpless grubs of *Diotoma undulata* so abundant that they have no need to hunt for anything else.

The larva figured in the accompanying plate measures up to 2½ inches in length, and is broad and swollen in proportion. The square shovel-shaped black head is flattened and excavated in front above the palpi and three-jointed antennæ, and furnished with powerful curved jaws. The three thoracic segments are smooth, shining, deep brownish-yellow, the first about twice the length of the following ones, which are slightly broader, each furnished with a pair of stout legs terminating in fine-pointed claws; the abdominal segments broader and more swollen, of the same rich colour, rounded on the outer margins, with the small anal segment terminating in a roughened warty process with forked tails; the under surface produced into a curious tubular box turned downward protecting the anal opening.

It is a very active savage creature, bending its head round when carelessly handled and biting viciously. When placed on a smooth surface the head is pressed flat down and apparently assists it in moving along, while the tubular or box-like structure projecting beneath the anal segment seems also in its locomotion. The whole insect with its flattened shovel-shaped head, tapering form, and powerful legs, is admirably adapted for the life it leads, pushing its way through the decaying bark.

These larvæ are full fed between the end of October and the middle of November; when they stop feeding, become more or less sluggish, and finally set to work and flatten out the surrounding rotten bark into an oval cavity or chamber, in which they pupate, under the shelter of the outer surface of the tough pine bark.

Mr. Saladine sent me several of these oval chambers containing the perfect pupae about the middle of December, cut out of dead pine trees at Brooklana. In the middle of the following February, while stripping the rough bark off some felled pine logs in the same locality, I obtained a pair of perfectly-formed beetles resting in the pupal chambers just ready to emerge. This beautiful beetle is up to 2 inches in length, but is somewhat variable in size. The males are usually the smallest, having the antennæ more serrate than those of the females.

The ground colour is dark-brown, but the whole of the upper surface of the prothorax and wing covers are so thickly variegated

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with silver-grey scales (pubescence) that the ground colour is obscured with a rich silver-grey striated pattern, giving it a very striking appearance. The undersurface of the body and legs are clothed with longer yellowish-brown scales, ending in a fringe of dark-brown hairs round the tip of the abdomen. The pattern and arrangement of the scales on the dorsal surface of the beetle is admirably depicted in Miss King's figure accompanying the plate. Unfortunately, freshly-bred specimens if killed too soon after emergence become greasy, become black, and lose all their beautiful silver markings. This discolouration can be removed by soaking the greasy specimen in benzole or chloroform. This fine beetle was originally described by the French naturalist, M. E. Candeze, in his "Monograph of the Elateridae," published in the "Memoires de la Societe Royale des Sciences de Liégo," in 1857, and the locality given is Sydney. Most of the others described were vaguely listed from New Holland. We know now that these giant click beetles are typical forest insects, and the nine species he recorded and described range from the coastal forests of northern New South Wales along the Queensland coast to Cape York.

THE EUROPEAN FURNITURE BEETLE.

(*Anobium punctatum.*)

THE typical genus of the family Anobiidae which contains some of the most destructive timber pests in the world, is the genus *Anobium.*

They are all small greyish-brown beetles averaging about 1-6th of an inch in length; elongate or boat-shaped in form, and easily identified by the peculiar shape of the prothoracic segment, which projects over the head like a cowl. When disturbed or frightened the beetle contracts its neck, drawing its head under the shield-like prothorax, and when examined looks as if it were headless.

There are several species with a world-wide range; but the cosmopolitan beetle common in New South Wales and other parts of Australia is *Anobium punctatum.* This species is identical with *Anobium domesticum* Geoff, popularly known as the European furniture beetle, though some English naturalists call the Furniture beetle *Anobium striatum,* Oliver. In referring to Junk's Catalogue of the described species of the family, published in 1912, De Geer has fourteen years' priority over Oliver, as he described *Anobium punctatum* in 1774, and the latter naturalist did not define *Anobium striatum* till 1790; while *Anobium domesticum* was not described by Geoffrey until 1785.

The best known *Anobium* in England is that known under the name of the "Death Watch." It is generally considered to be *Anobium tessellatum,* the largest British species; but Professor Westwood says that this is a mistake, and that this species is seldom or never found in the woodwork of houses or furniture, but it lives in rotten wood in the forest, and he "bred the beetle from larvæ which had taken three years to develop in a rotten white thorn."

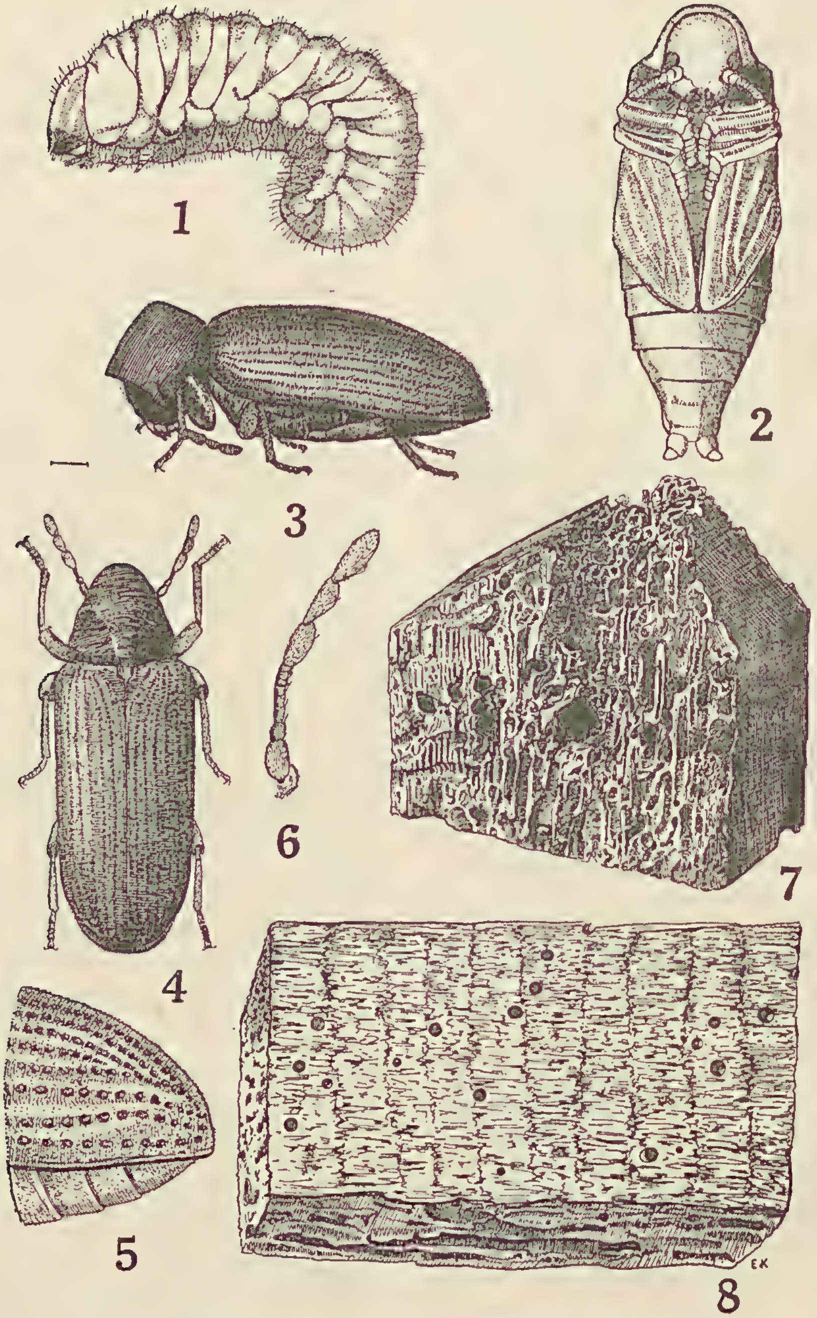
Westwood states that it is the smaller *Anobium domesticum* which causes the sound that has led to the name of the "Death Watch." If he is correct, and *Anobium domesticum* is identical with *Anobium punctatum,* then the common New Zealand white pine species, so common in Sydney, is the "Death Watch."

The adult beetles, when boring in the woodwork of old houses, or furniture, have the curious habit of raising their head and thorax and, tapping the roof of their tunnel a number of times, they make a distinct ticking sound, which is simply a signal to each other. This distinct tap is repeated to nine or eleven times without intermission; the beetles being hidden in the damaged wood, are seldom observed though often heard. This call-note habit has led to all kinds of curious ideas about the origin of this sound. Many references are found in English literature to the Death Watch. One writer says: "The fate of many a nervous and superstitious person has been accelerated by listening in the silence and solitude of the night to the imagined knell of his approaching dissolution."

Dean Swift appears to have been the only one of the earlier writers I can note who had any practical ideas about the Death Watch. In a poem he wrote on this beetle, after describing the insect, he concludes:

"But a kettle of scalding hot water injected
Infallibly cures the timber affected;
The omen is broken, the danger is over,
The maggot will die, and the sick will
recover."

PLATE XV.



Life History of the European Furniture Beetle

(*Anobium punctatum*, De Geer).

1. Larva of *Anobium punctatum*.
2. Pupa of " "
3. Lateral view of beetle, *Anobium punctatum*.
4. Dorsal view of beetle.
5. Tip of abdomen and wing covers showing punctures.
6. Antennae of beetle.
7. Pine block from leg of imported piano destroyed by *Anobium punctatum*.
8. Piece of New Zealand white pine taken from the back of a kitchen dresser damaged by *Anobium punctatum*.

If the beetle now so common in Sydney houses is identical with the English "Death Watch" beetle, it is curious that no one has recorded hearing its ominous tap in the silent watches of the night.

This beetle is a modern introduction into our house timbers, and hardly noticed in infested furniture till within the last ten years. It is not listed among the introduced beetles in Master's Catalogue of the described Coleoptera of Australia published in 1885; whereas at the present time it is being constantly brought into the Museum for identification.

Anobium punctatum attacks many different kinds of old seasoned timber fittings in houses, old valuable furniture and is responsible for the destruction of many of the old wood carvings in churches and cathedrals in England. While they are often found in furniture in Australia, they are more common in kitchen furniture, and in other stained wood furniture which has been backed with New Zealand white pine. In nine out of ten cases, when discovered in floors or lining boards, on investigation this timber infested is found to be New Zealand white pine.

This is so well known that we might very well call this particular borer the "New Zealand White Pine Borer" instead of the European Furniture Beetle.

The writer is informed on the best authority that the liability of New Zealand white pine to infestation when dry and seasoned by Anobium beetles is so well known in New Zealand that this timber is never used for constructional purposes in its native land. Last year New South Wales imported over 22,000,000 feet of timber from New Zealand, the greater part of which was white pine.

The importation of old seasoned furniture and timber from the Old World must have carried the anobium beetles into Australia at a very early date; but either unsuitable climatic conditions, or the different character of our native timbers, must account for their slow development from this source.

Therefore, it is evident that the serious infestation now taking place in Sydney in floors, woodwork, and furniture is due to the use of New Zealand white pine (the timber of *Podocarpus dacrydiodes*) in New South Wales.

I do not think that this timber, used in the manufacture of the greater portion of the kitchen furniture in Sydney on account of its colour and cheapness, is infested by any eggs or larvæ of anobium when it is distributed from the factories, because it is made of timber that was not seasoned before it left New Zealand.

Unlike other well-defined groups of timber-infesting beetles, which attack the wood from the time the tree is felled until the sawn wood is seasoned, the anobium beetles do not infest anything but seasoned wood. Therefore such furniture may remain perfectly sound and free from borers for years; but the older and more seasoned it becomes the more suitable it appears to be for anobium beetles and their larvæ. The casual introduction of a packing case or butter box (usually made of the inferior white pine timber) containing the larvæ of anobium beetles may lead to the infestation of all the surrounding furniture and suitable timber, years after such furniture was purchased. On account of its cheapness, many white pine floors have been put down in Sydney, and have remained perfectly sound and undamaged for years; yet they are never safe from outside infestation by the adult beetles emerging from infested woodwork or waste boxes or from accumulated lumber about the house.

I have seen flooring boards, said to have been down twenty years or more, absolutely honeycombed by several generations of larvæ and beetles before the damage was noticeable from the appearance of the flight holes of the emerging beetles on the outer surface.

It is not an uncommon thing at the present time to be called in to a house to see the stained or painted lining boards of a room, or the back of a wardrobe or dresser, all spotted with hundreds of circular holes. These holes are the flight holes of the adult beetles; they have developed from the larvæ that have been feeding unnoticeable in the heart of the timber.

In Europe the anobium beetles both lay their eggs and also bore into a number of the best furniture and building timbers, such as oak, elm, pine, and beech, and are carried about in old second-hand furniture. In Australia, however, they do not attack our native timbers, although they have been doubtfully recorded from kauri pine floors. In every case where I have found the infestation and damage caused by an anobium it has been in New Zealand white pine. When discovered in furniture, if not stained or polished white pine, it is in some foreign timber.

According to entomological investigations, the insect fauna of New Zealand is very rich in species of beetles belonging to the family *Anobiidae*. Brown has described four distinct species of the genus Anobium as peculiar to these islands; and a number of other closely-allied forms belonging to other genera of the family. It would therefore appear that the distinctive forest flora of New Zealand or climatic conditions are more suitable for *Anobium punctatum* than Australia, and this accounts for the fecundity of this European species.

Builders, architects, and house-owners should be warned against using New Zealand white pine, the latter in particular, because in the end the loss falls on the owner of the house, as even if the timber is infested with the larvæ of anobium when placed in position there is no outward evidence of their presence, and the flight holes may not appear till two or more years later.

This matter is such a serious thing that I think that not only should the Government see that no New Zealand white pine is used in their buildings, but an Act should be passed to prohibit builders and contractors from using this timber in constructional work.

The infestation of sawn timber and furniture takes place in the early summer; and, in Sydney, the fully developed beetles are cutting their flight holes through the outer surface of the wood in December and January. These beetles mate, and the females will lay their eggs in the seasoned white pine, previously free from them, while some will reinfest the wood from which they have emerged.

The damage caused by Anobium can be easily distinguished from that of all the other groups of wood-boring beetles. The larvæ gnaw out large parallel burrows, which, as they move along, may be full of live wood dust; but this dust is not solidly packed behind them like those formed by powder post and Auger beetles. As the larvæ increase in size and numbers there are many crossway galleries, until the whole board is honeycombed all through, yet with an unbroken outer surface until the beetles are ready to escape. Then the board is covered with their circular flight holes. In an infested floor there is not much evidence of the wood dust; but from lining wall timber the dust falls freely upon the floor.

In many cases further damage may be checked, if taken in time, by treating the surface of the damaged woodwork or furniture with turpentine, creosote, or kerosene, or a mixture of the latter two. The penetrative power of all these is assisted by the flight holes on the surface.

All the specifics advertised are compounded of mineral oils such as kerosene and various forms of creosote; and it is the contact of these liquids that destroys the eggs, larvæ, and beetles remaining in the damaged wood.

If the application of the oil or creosote is thorough it will kill everything it touches, and no fresh investation need be feared from outside.

Many of the dealers in timber borer specifics add arsenic in some form to their liquid oil blend; or claim that they contain expensive and extra deadly carbolic compounds. Arsenic, or paris green, is a very good thing to blend, or hold in suspension in wood oil or creosote when treating joists, piles, rafters and the under surface of floors to protect them from white ants and other pests, when the house is building or old floors are being replaced. Where the timber has become infested, but the infestation is slight, oil or creosote is quite effective; and where these are objectionable on account of smell or stain when used in interior work kerosene and turpentine can take their place. Therefore why add poisonous chemicals when the penetrative liquids do the work. I find that many house-owners, alarmed at the dust and holes of borers, both powder-pest beetles and anobium beetles, immediately think that the infested roofs or floors are going to crumble away. Naturally frightened, they are quite ready to tear down slightly-damaged woodwork or to pull up floor timber on the advice of so-called experts; whereas a few pints or gallons of creosote and kerosene judiciously applied will renew the life of the timber for many years for a trifling cost.

PARASITES OF TIMBER BORERS AND A TIMBER WASP.

In a previous article (page 29), I dealt with some of the Predatory Parasites of Timber-boring Beetles. In this paper I add two more found in imported timber, where they were pupating in the chambers of Bostrychid Beetles. The third is an indigenous Histerid Beetle, which is so plentiful towards the end of the summer in the tunnels of our shot-hole borers that it must account for the destruction of a large number of these destructive beetles.

Two hymenopteron parasites are figured and described, one a small Braconid Wasp bred from a beetle-infested tea chest from India. The second a new species of the genus *Aressida,* which are parasitic in the larvæ of different timber-infesting weevil beetles. And the last a rare Saw-fly (*Oryssus*), which bores into rotten timber and pupates in the dead wood.

The Metallic Blue Clerid.

(*Cylidrus cyaneus,* Fabr.)

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The beetle was originally described by Fabricius under the name of *Clerus cyaneus* in 1787, and has since been described under at least three other specific names. It has a wide distribution in the East, and I have cut several out of the sapwood of Red Lauan timber imported into Sydney from Manila, where these beetles were feeding upon the larvæ of the slender Bostrychid Beetle (*Xylothrips flavipes*).

The adult beetle when it has completed its metamorphosis in its host's chamber, cuts its way out through the galleries previously made by the borer, to the surface of the wood.

Its general colour is rich metallic blue with greenish reflections on the prothorax and head; the eyes, terminal joints of the antennæ, tibiae, and tursi of the legs; wings, and extreme tip of the abdomen black; the thighs of the legs and the abdomen reddish yellow. It varies considerably in size, the largest being nearly half an inch in length.

The Small Hectarthrum.

(*Hectarthrum latum,* Grouv.)

This beetle was taken out of the same beetle larvæ infested sawn timber imported from the Philippines, as the previously described clerid beetle.

It is, I think, identical with the second species of the Genus *Hectarthrum* recorded from these islands, which was described by Grouvelle in a paper entitled "Cuciujides nouveau on peu connus," published in the Annals de la Societe Entomologique de France, 1876 (p. 448, plate 8. fig. 2).

It differs from the larger cosmopolitan species known in Australia as *H. brevifossum* in size markings on the dorsal surface of thorax and wing covers, and the form of the antennæ.

The Shining Black Hister.

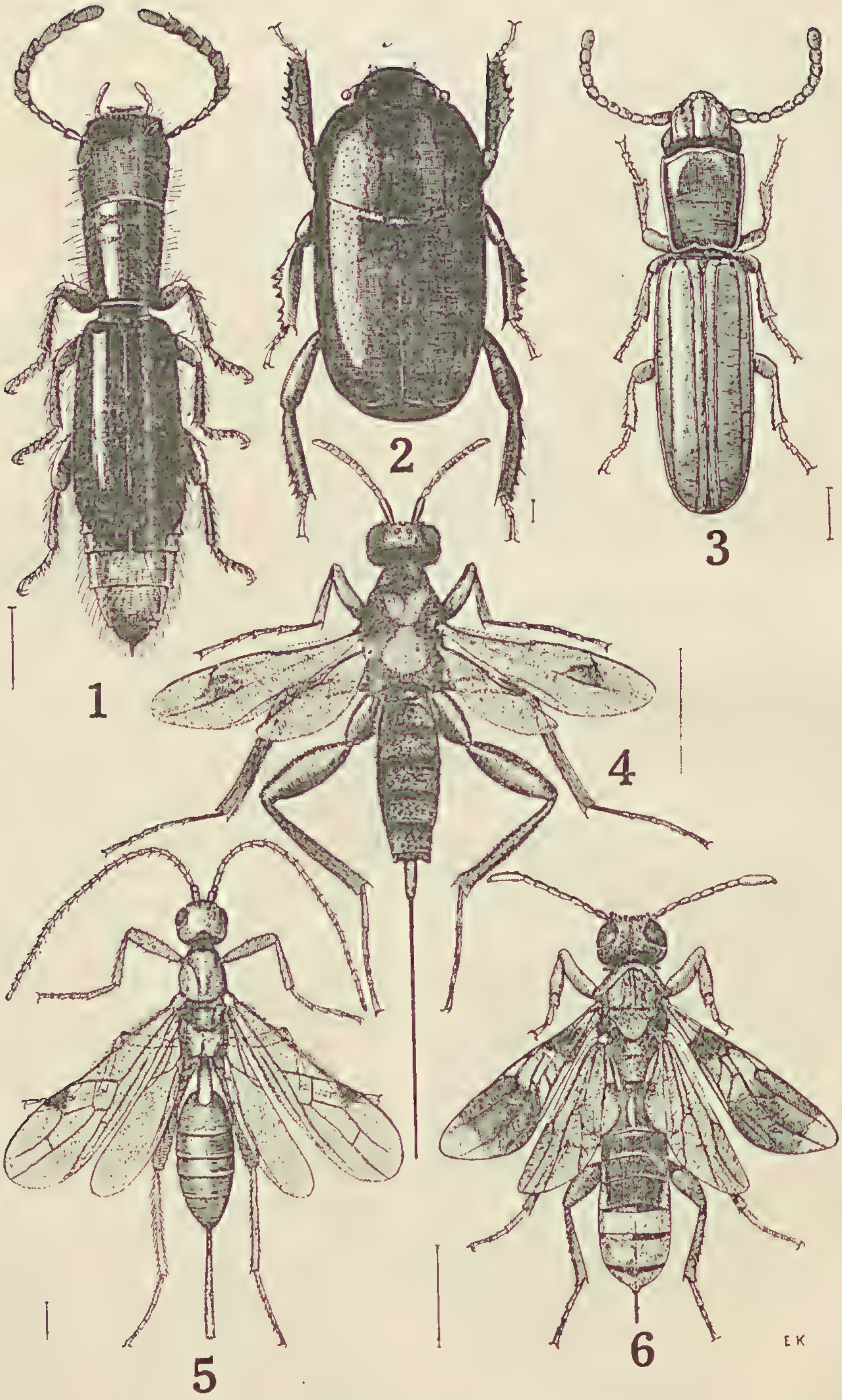
(*Teretriosoma melburnum,* Marshall.)

This beetle was originally described by Marshall under the name of *Teretrius melburnius* in a paper entitled "Descriptions of new species of Histeridæ," published in the Annals of the Entomologique, Belgium, 1870. In Master's "Catalogue of the Described Coleoptera of Australia" it is recorded from Victoria and New South Wales.

I have found it plentiful, particularly towards the end of the summer, sheltering in the shot-hole bores and galleries of the two small Bostrychid Beetles, *Xylion collaris* and *Xylodeleis obispa* in the Spotted Gum (*Eucalyptus maculata*), all through the South Coast forests; under the same conditions I have collected them at Batlow when cutting out other pin-hole borers in the Mountain Gum (*Eucalyptus dalrympleana*). In other borer-infested gum tree logs at Narrabri and the Dorrigo forests it is not uncommon, so that it evidently ranges all through our coastal forests where Bostrychid Beetles attack timber.

This beetle varies considerably in size up to about one-eighth of an inch in length, and is very broad in proportion to its length. General colour, shining black; the clubbed antennæ and legs reddish-brown; the whole of the upper surface is finely punctured: beyond the tips of the abbreviated wing covers the exposed portion of the tip of the body is more closely punctuated. Short thick-set and rounded in form; it shams dead when touched, but with its well-developed stout legs it is an active little beetle, and feeds upon the adult borers, capturing them when helpless in their burrows.

PLATE XVI.



Parasites of Timber Borers and a Timber Wasp.

1. *Cylidrus cyaneus.*
2. *Teretriosoma melburnum.*
3. *Hectarthrum latum.*
4. *Aressida imperialis,* n.sp.
5. *Spathius* sp.
6. *Oryssus queenslandicus.*

The Golden Sawfly.

(*Oryssus queenslandicus,* Turner.)

In cutting up decayed brush timber logs in the Brooklana Forest, Dorrigo, a number of both beetle and hymenopterous larvæ and pupæ were obtained, from which the perfect insects were developed in the Forestry laboratory.

Among them was the pale yellow pupa of this beautiful and rare wood wasp; the perfect insect emerged on the 16th October, 1924.

The type specimen was originally described by the late Gilbert Turner in the "Proceedings of the Linnean Society of New South Wales, 1900." He captured two specimens on the wing in the forest near Mackay (North Queensland). No other specimens, as far as I know, have been collected since that date. The present record brings the insect far south into this State.

The Sirex-like form of this wood wasp is well brought out in Miss King's drawing on the accompanying plate, so that I shall confine my description to size and colouration. Length from front of head to tip of abdomen, including the ovipositor, half an inch. General colour, shining black; the forewings semi-transparent, variegated with black and white; nervures, reddish brown; hind wings, iridescent, slightly clouded with brown. The front portion of head and prothorax finely rugose with silvery pubescence on the back of the head. The whole of the abdomen blotched with golden pubescence on the sides, with the three terminal segments completely clothed with similar bright pubescence.

The Imperial Aressida.

(*Aressida imperialis,* n.sp.)

The members of this beautiful genus of Chalcid Wasps are parasitic upon the larvæ of different timber-borers belonging to the family *Curculonidae*; the adult wasps are usually taken resting upon larvæ-infested timber in the forest. The pupa rests in a cavity in the dead wood, folded up in a delicate membrane, without any cocoon.

Cameron described two species, "Proceedings of the Linnean Society, New South Wales, 1912," from specimens I sent him. One, *Aressida annulicornis,* bred by Mr. L. Gallard from the larva of the widely-distributed Weevil (*Euthyrrinus mediatabundus*), which infests the dead stems of the Bangalow Palms in the Gosford district. The second species, *Aressida nigricornis,* was taken on the wing near Sydney. I have obtained another specimen of the female of the latter species from dead wood containing beetle larvæ collected at Brooklana, Dorrigo, to which, on account of its brilliant purple tint, I propose the name of *Aressida imperialis.* This species figured on the plate, of which I have bred both sexes from a decayed section of a scrub log containing both weevil and longicorn larvæ and pupæ. The larger female measures one-third of an inch from the front of the head to the tip of the abdomen; the extended ovipositor, ¼ inch. The head, basal joint of the antennæ and eyes black; the front of the head clothed with golden pubescence, with rich metallic green round the insertion of the antennæ, which, except the scape, are light reddish-brown, slightly clouded at the base of the second and apical joint with brown. Dorsal surface of the thorax, black, deeply blotched with dull metallic purple; wings semi-transparent, with irregular brown blotch towards the tip of the fore wings; nervures, brown; legs, variable in colour, fore pair light reddish-brown, middle pair with femur of the same colour, but tibiæ and tarsi black; the hind pair black, with purple reflections; a white band on the base of the first tassal joint. Abdomen deep metallic purple barred with black; ovipositor, black. The male, much smaller than the female, measures a quarter of an inch from the front of the head to the tip of the abdomen. The antennial joints more swollen, and all black. The front and second pair of legs all light reddish-brown; the hind legs long, coppery metallic green, with the trochanters forming swollen lobes on either side of the small oval abdomen, the thighs swollen, tibiae, and tarsi long and slender. The small oval abdomen flattened on the dorsal surface, smooth, shining, rich, metallic purple.

The Tea Chest Braconid.

(*Spathius,* sp.)

Some two and a half years ago a consignment of low-grade tea was imported from India, packed in tea chests made of soft three-ply wood. Several cases on their arrival in Sydney were so badly infested with the larvæ of a Bostrychid Beetle, that they crumbled to pieces, and were seized in consequence by the quarantine officers.

The woodwork of the chest was handed over to me for report, and the tea destroyed, because it was full of the beetle grubs which had fallen out of the case wood.

Kept under observation for some months, I bred out a large series of the beetles, which were identified as *Heterobostrychus aequalis,* a Bostrychid Beetle which has a wide range over the East.

A large series of hymenopterous parasites bred out of the woodwork, which have been identified at Washington, U.S.A., as an undetermined species of the Braconidæ, *Spathius* sp.

The general colour of this Braconid is honey-yellow, the thorax and abdomen lightly marked with darker brown; wings semi-transparent, with the nervures dark-brown. The abdomen flask-shaped, slender at the base, ovipositor stout, about the length of the oval portion of the abdomen. Length of female, one-sixth of an inch.

The male is much smaller than the female, with the abdomen more elongate from the base and rounded at the apex.

The Genus *Spathius* contains forty-seven described species, and the range of the group is almost world-wide. North and South America contain thirty species; eight are recorded from Europe, probably some of which have been accidentally introduced with timber from the East, and three are described from Ceylon, one of which is probably our introduced species.

THE HAIRY BROWN CYPRESS PINE APHIS.

(*Dilachnus callitris,* n.sp.)

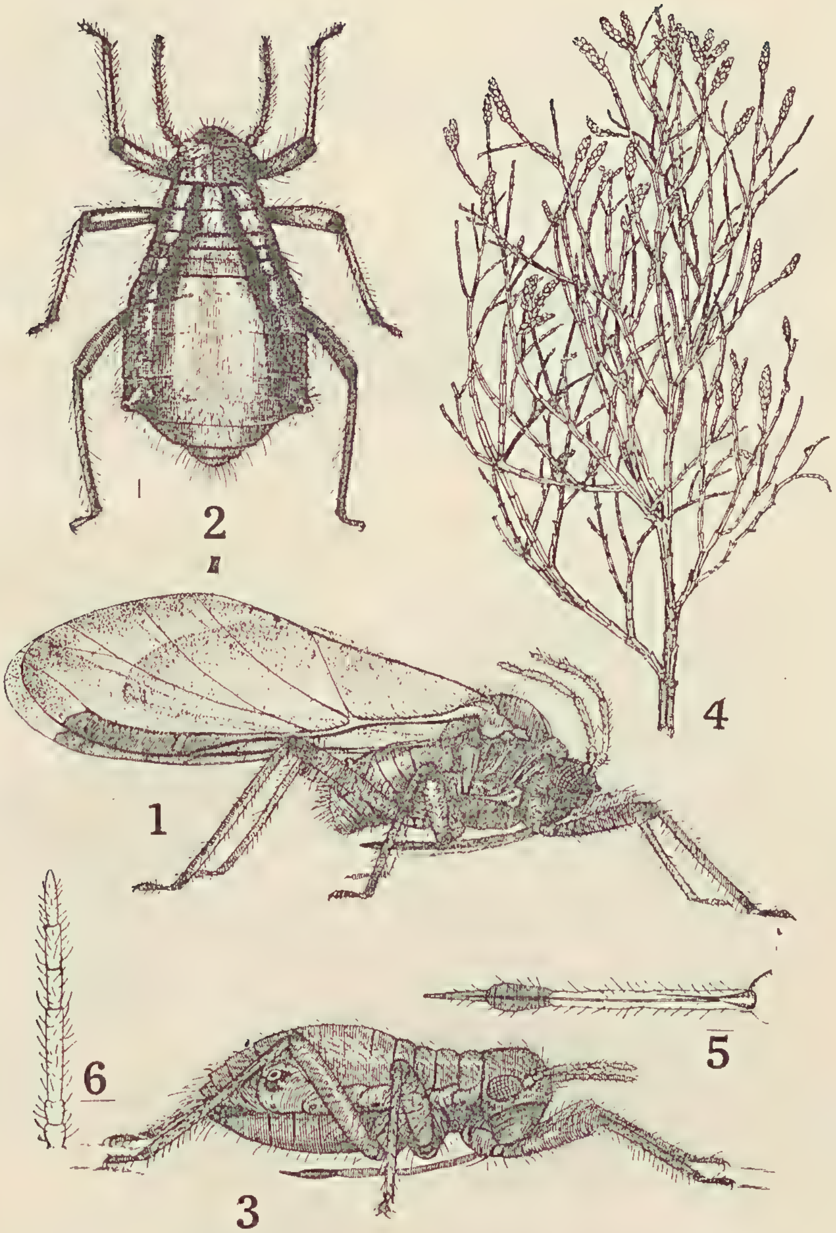
Though there are a large number of aphids found in this country infesting and causing a considerable amount of damage to plants, they are all foreign species that have been accidentally introduced into Australia with plants from overseas. It is very noticeable that though often plentiful most of the plants that suffer from their infestation are not natives of this country.

Their place is taken, upon the Australian flora, by the Lerp insects or *Psyllids,* belonging to the allied Homopterous Family *Psyllidae.* These tiny little cicada-like creatures feed upon the sap of foliage or branchlets in the same manner as the aphids, but both sexes always have two pairs of well-developed wings, though their life histories are very variable, some in the larval state producing protective scales like the coccids, others form leaf galls, while many are marked like aphids, or cover themselves with white flocculent secretion. In the Forest Insects of Australia I gave a general account of this fine, evidently indigenous, aphis, under review, and now go over somewhat the same ground, but illustrated with a fine plate by Miss King, showing its life history. In August, 1921, this Cypress pine aphid was first brought under my notice by Mr. Blakely, of the Botanic Gardens, who collected specimens of infested sprays of Cypress pine from the western forest scrub near Narrabri. Within a few weeks I received specimens from other districts, among them some from the District Forester of Dubbo (Mr. A. R. Samuels). He stated that all through the west the Cypress pine forests were so badly infested that the foliage of the large trees was wilting and turning yellow.

Shortly after I received the specimens I visited the Dubbo district to study the pest under natural surroundings. At the time of my visit the aphis were migrating from the older Cypress pine trees and swarming up the stems and young branchlets of the small trees. In many cases they were so abundant that several feet at a stretch of the stems were encrusted with closely-packed aphids sucking the sap out through the bark and sprinkling the surrounding foliage with the overflow honey dew.

In the area first infested I found hundreds of the Red-spotted Ladybird beetle (*Leis conformis*) taking charge and devouring the aphis. With such an abundance of food surrounding them they bred up so rapidly that in a comparatively short time the trees were cleaned up and recovering all over a large area of the Dubbo forest lands. I had no record of the reappearance of the Cypress pine aphis, until last October (1925), when Mr. Keith McKeown. at Leeton, sent me a box of aphis-infested Cypress foliage from the Irrigation Area, but in this case the pest was confined to a limited area. The larval forms are more slender in form than the adult aphids, and appear to be more thickly clothed with fine hairs. The colouration is similar, but the shorter six-jointed antennae stand out in

PLATE XVII.



Life History of the Cypress Pine Aphis.

Dilachnus callitris, n.sp.

1. Adult winged form.
2. ,, wingless aphis.
3. Immature larval aphis.
4. Spray of Cypress Pine.
5. Rostrum of adult aphis.
6. Antennæ of adult aphis.

front of the head. The rostrum very much developed and folded under the body when at rest.

The wingless adult short and broad, mottled reddish brown with indistinct lateral stripes on the body, and the sipuncles projecting but short and truncate. Winged aphid ¼ of an inch from the front of the head to the tips of the wings; general colour dull brown, mottled with dull yellow and black, the whole insect including the legs and antennae thickly clothed with fine brownish hairs. The semi-transparent wings are clouded along the costal margin; the nervures dull yellow, the surface of the wings and nervures clothed with tiny, pointed, erect scales.

THE HAIRY PIN-HOLE BORER.

(*Xyleborus hirsutus,* Lea.)

This destructive little pin-hole borer was collected in all stages of development in a number of White Ash logs in a Sydney timber yard. The logs had evidently been cut and left in the forest for some time before they reached the sawmillers. The outer sapwood was so thickly tunnelled with their bores, that it had to be cut well into the surface of the heartwood before the sound timber was reached.

Lea, who originally described this beetle in a paper in the Proceedings of the Linnean Society of New South Wales in 1893, "Descriptions of New Species of Bostrychidæ" called it doubtfully *Xylopertha hirsuta*, and said he had collected it from timber at Tamworth, Cootamundra, Tweed and Richmond Rivers, New South Wales. He does not mention anything about the particular timber it attacks, nor give any information regarding its life history. In a later paper (1904) in the same journal Mr. Lea places this and two other species of pin-hole borers which he had previously described in the genus *Xyleborus*.

This beetle measures slightly over one-tenth of an inch, and is of the usual cylindrical form, with turned-down head, admirably adapted for burrowing into the stems or felled logs. It varies in colour from light yellowish-brown to chocolate brown, according to age, but the lighter coloured ones are just as busy in the timber as the more matured specimens. They bore vertical shafts through the surface of the log for an inch or more in depth and then branch out into irregular lateral galleries, at the and of which, the semi-transparent larvæ feed and develop, and they, when full grown and developed into beetles, continue the galleries as long as the wood is moist and sappy.

There are two methods of dealing with these pin-hole borers to prevent them pin-holing the logs. The first is the prompt cutting up of the log into timber as soon as it is brought in from the forest, for as soon as the timber commences to dry, both the beetles and larvæ leave the wood, or die in the chambers they have excavated.

When, through want of transport, bad weather, or other causes, the logs remain in the forest or on the ramp, if they are treated or sprayed with a creosote or wood oil mixture, as soon as they are felled and barked, they will not be infested by any of the Scolytid beetle borers. Under the above conditions it would certainly pay timber getters and sawmillers to have such logs treated before their contents are reduced to second or pin-hole quality timber.

The habits of both the beetles and larvæ of these small pin-hole Scolytid beetles are very similar, and they excavate similar galleries. Usually they prefer the soft-timbered brush or scrub trees, particularly in the tropical forests, but in the forests of Eastern Australia some of them also infest our Eucalypts. This species, and two other *Xyleborus compressus* and *X. parvus* were described by Mr. Lea from districts where it is chiefly hardwood forest. In fact, as far as I know, *Xyleborus compressus* confines its attention to the hardwoods. I have collected it from burrows in spotted gum logs in the Moruya forests in January.

These two are easily distinguished from each other. *Xyleborus hirsutus* is reddish-brown or lighter coloured, more slender in form, clothed with fine hairs, and the punctures on the wing covers are small and well defined.

Xyleborus compressus is a broader, thickset beetle, with the tip of the wing covers more rounded, though ornamented with four small spines. It has a similar hairy covering, but the hairs are more scattered and irregular, and the punctures on the wing covers much coarser and ill-defined. The third species (*Xyleborus parvus*) is unknown to the writer. A fourth species, which attacks the fresh barked logs of Hoop Pine in the Dorrigo forest, according to Sampson, is a new species, allied to *Xyleborus confusus*.

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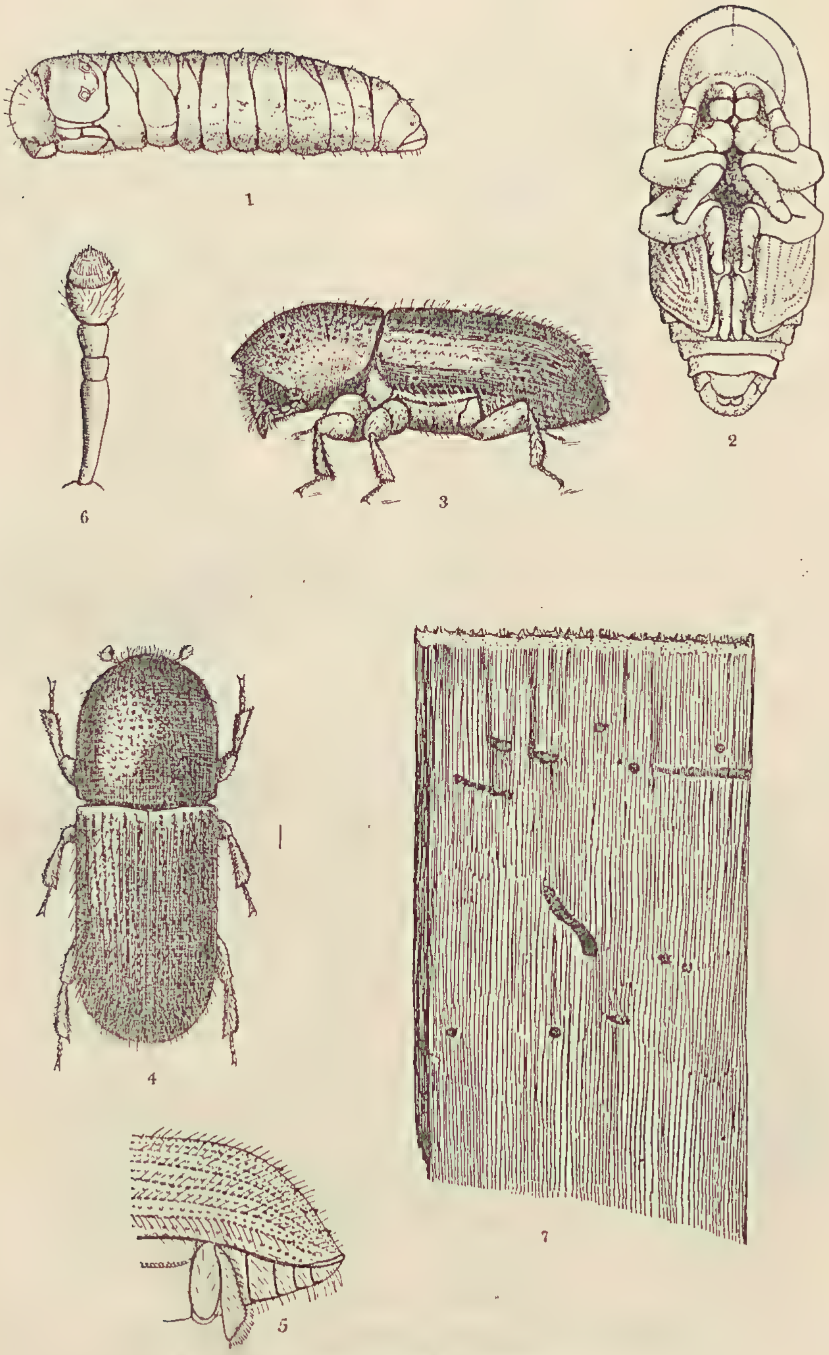
PLATE XVIII.



Life History of the Hairy Pin-hole Borer.

Xyleborus hirsutus, Lea.

1. Larva of *Xyleborus hirsutus*.
2. Pupa of *Xyleborus hirsutus*.
3. Side view of *Xyleborus hirsutus*.
4. Upper view of *Xyleborus hirsutus*.
5. Tip of body of beetle (enlarged).
6. Antennæ of beetle (enlarged).
7. Showing section of White Ash timber attacked by beetles

THE GREGARIOUS GALL-MAKING WEEVIL.

(*Strongylorrhinus ochraceus*, ~~Schönherr.~~)

Early last June the District Forest Officer (Mr. H. J. Lyne) forwarded some swollen stem galls, formed upon the stems of coppice ironbark trees (*Eucalyptus siderophloia*) growing in the Karuah Forest near Clarencetown, New South Wales. On examination, these gouty swellings of the stems formed just above the ground, proved to be of insect origin, the largest containing over 100 beetle larvæ resting in circular chambers just beneath the rough bark.

Last September I visited the infested area under the guidance of the Forest Officer stationed at Dungog (Mr. Higgins), and examined the galled trees. Previous to my visit the foresters had experimented, by burning round the base of the galled trees, but without much success, as the thick, rough bark formed an effective barrier against all heat, which could be used without injuring the trees.

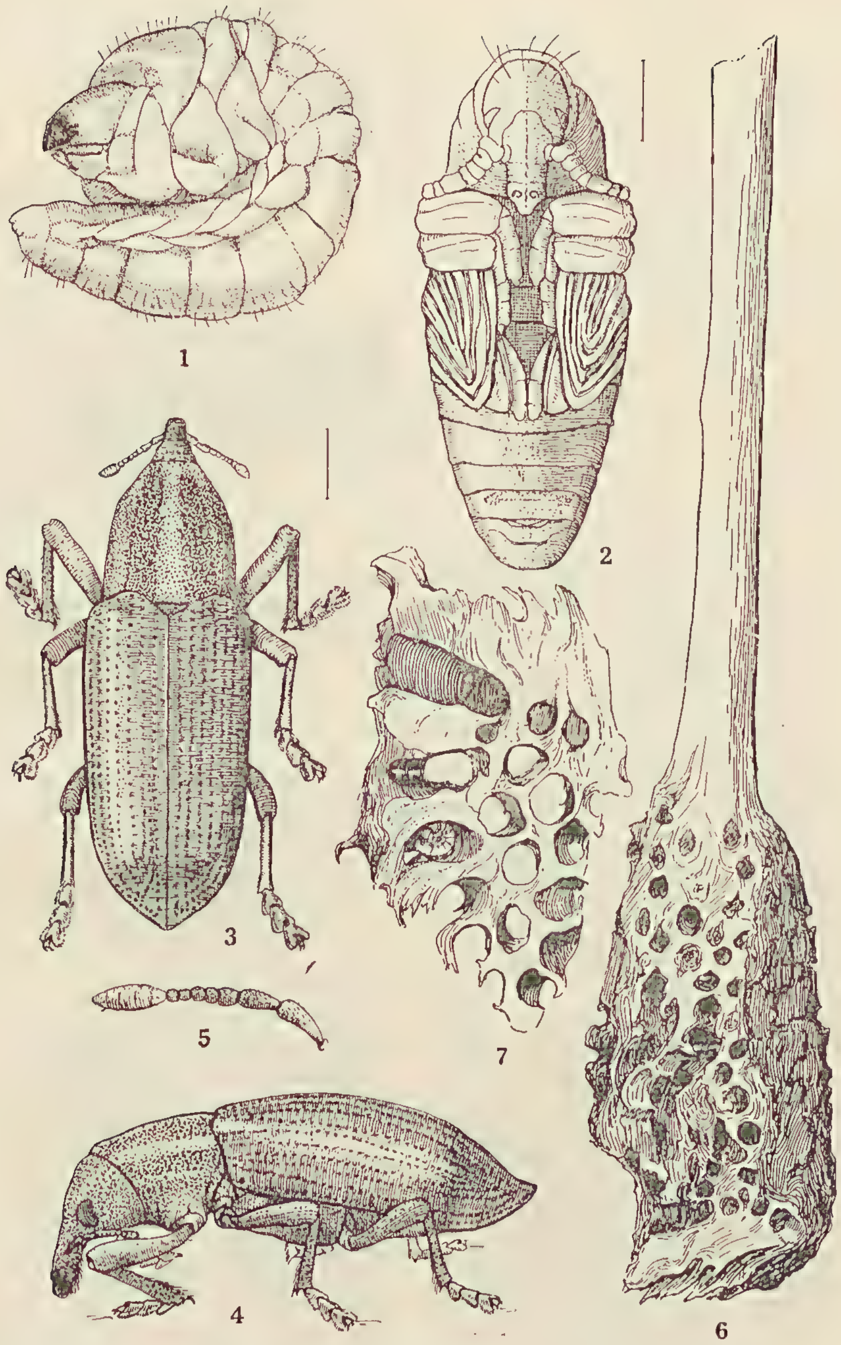
The actual age of the galls from the time when the eggs were deposited in the bark is hard to estimate, but from the fact that at the present date (March, 1926) many of the specimens exposed on the larval pits are well developed pupæ, it is probable that their life cycle is about twelve months. The beetles evidently puncturing the rough bark with their sharp jaws, deposit their eggs in a regular pattern right round the stem, The resultant larvæ gnawing their way through the bark into the sapwood beneath. The united action of these wood-eating larvæ burrowing downward causes the injured wood tissue to accumulate round the infested area, forming irregular, elongate, rounded galls, four or five times the diameter of the normal stem of the coppice gum tree above and below it. These woody galls or gouty swellings vary from 4 to 8 inches in length and 3 or more inches in diameter.

The enveloping bark is somewhat roughened and marked with gum cracks; when the surface is removed, the bark beneath will be found dotted with dark brown rounded patches, which indicate the larval burrows, the brown substance being a wad of waxy kino protecting the imprisoned grub. When this wad is removed, the larval pit is exposed, showing the curled-up larva in its chamber. When the whole of the bark is stripped off the woody gall, a regular network of these cells is revealed each about a quarter of an inch in diameter, and over half an inch in depth; in the large galls there are a hundred or more of these cells, each containing a beetle larva. The larvæ in the earlier stages of their development evidently feed upon the bark and surrounding wood tissue when forming the pits or chambers, but when they have reached a certain stage, if they feed at all, must obtain their nourishment from the exudations of the surrounding wood or the surface of the cell cap, as the inner surface of their chambers are quite smooth, hard, and often blackened. The enclosed larva can move up and down the vertical chamber, which is free from all frass and wood dust, and much deeper than the larva even when extended to its full length.

The larvæ examined in September and October were of a uniform dull yellow tint, curled up in their chambers like a "wood louse" or "slater," the head and prothorax turned down under the body, the tip of which touches the front of the jaws; they remained curled up like this even when removed from the galls. When examined in January they had increased in size to half an inch in length, and the general colour was of the same dull yellow, but the outer margin of each of the thoracic segments was swollen out into a rounded semi-transparent lobe, causing a considerable addition to the size of these segments behind the slightly cylindrical projecting head. The abdominal segments rounded on the upper surface, flattened on the under surface, with the anal portion coming to a point. The pupa, taken from the chambers at the last date, are of a uniform dull yellow tint, the folded-down head and thoracic segments clothed with scattered fine spiny hairs, with finer spines on the dorsal surface of the abdominal segments, and the short wing covers which curl round the body are deeply fluted. They, like many other wood-boring weevil larvæ, remain in the pupal stage for a considerable time, probably some months.

The perfect beetle measures about ½ inch in length from the front of the head to the tip of the wing covers; some bred from the galls are much smaller. General ground colour light chocolate brown, with the head, basal joints of the antennæ, prothorax, and legs clothed with rusty scales; the wing covers very finely punctured with a lighter

PLATE XIX.



Life History of the Gregarious Gall Weevil Beetle (*Strongylorrhinus ochraceus*).

1. Larva of *Strongylorrhinus ochraceus.*
2. Pupa of *Strongylorrhinus ochraceus.*
3. Dorsal view of adult beetle.
4. Lateral view of adult beetle.
5. Antennae of beetle.
6. Galled stem of Ironbark sapling.
7. Section of galled stem showing structure.

tinted scale in each puncture. Usually fresh unrubbed specimens show lighter coloured parallel lines on the prothorax.

One specimen of the beetles matured in the end of January, a second on 12th March, but no others have emerged since, though there are a number of advanced pupæ in the gall chambers. Though some will probably emerge about the end of March, others sheltering in undisturbed galls may remain quiescent over the winter, for wood sheltering weevil larvæ and pupæ are very variable in the time they take through their life cycle.

This beetle was originally described from Tasmania by Schönherr in his "Mantissa Secunda," but he simply defined the genus. G. R. Waterhouse noted this, and describes it in a paper "Notes on the *Strongylorrhinus ochraceus* of Schönherr and description of two nearly allied species of *Curculonidæ* from Australia," Trans. Ent. Soc., London, 1862, p. 227). I have taken single specimens upon small gum trees from time to time in New South Wales, and have several specimens from Western Australia. I am indebted to my valued correspondent, Mr. John Clark, of the Forestry Service of Perth, for some notes on its range and habits in Western Australia. He writes: "This beetle confines its attention to the 'flooded gum' (*Eucalptus rudis*), and galls them not on the stems near the ground, but upon the branches of the trees. The beetle flies in spring or early summer. The female bores a small hole in the stem with her snout, in which she lays her eggs; the holes are about 1 inch apart." It is therefore evident that the habits of this beetle in West Australia are somewhat different to those in New South Wales. If it is proved that the bulk of these beetles do not emerge till after the winter, it might be practical to destroy them by burning them off the galls.

There are a large number of coppice ironbarks galled all over the forest; so if all these beetles develop and emerge under conditions which are favourable, every female will be able to gall another tree, and the damage will be very much more serious through the forest in the following year than at present.

I have only bred one parasite from the half-dozen galls under observation in the tins, and from the protective structure of these massed cells they are not in much danger from hymenopterous enemies. Yet fungus or other germs may keep them in check under forest conditions, for under laboratory surroundings the bulk of them develop fungus when the galls are kept for any length of time. If all the beetles emerge about the same time, it might be practical to destroy them with a torch or oil spray before they move off to find fresh trees to infest.

THE RIDGE-TAILED BORER.

(*Amasa truncata,* Erichson.)

This pin hole borer is a very interesting beetle, because, as far as my observations have gone, it confines its attention to small areas of damaged wood in living trees.

Young gum trees are not uncommon in the forest where the stem has met with an injury, often caused through a felled tree or falling limb cutting off a piece of bark. This exposed wood turns brown, the dead surface is surrounded by, and it is resting on, living wood. In each instance when I have found these beetles, I have cut them out of such damaged tree stems.

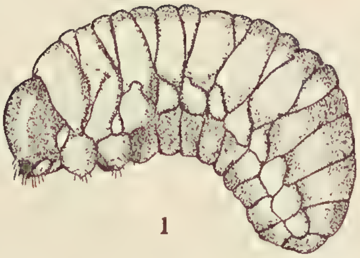
Towards the end of last May, 1925, I first discovered these borers. With the District Forester, Mr. H. W. Garling, I was investigating the damage caused by timber insects in the red gum saplings (*Eucalyptus rostrata*) on the banks of the Lachlan River, near Forbes. During the last few years these seedlings have grown up into stout saplings, forming regular dense thickets on the low lying flats.

We came across such a sapling as previously described, showing outward evidence of borer infestation by the pin holes dotted over the damaged brown patch.

Cutting down this damaged sapling, and splitting up a portion of the pin holed section, I found several beetles; these occupied vertical burrows, varying from ¼ to ½ an inch in depth, connected beneath with flattened keyhole-like chambers. When this wood was split up, over fifty pale yellow pupæ, and whitish larvæ in about equal numbers were exposed to view in one of these chambers. As the larvæ were apparently full-fed, May is evidently about the season of pupation.

On the 23rd November when going through the Ourimbah State Forest, I found a similarly damaged sapling to that described on the banks of the Lachlan River. In this case it was a coastal blue gum (*Eucalyptus saligna*) infested by the same beetle.

PLATE XX.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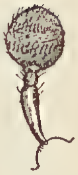
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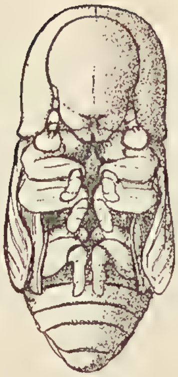
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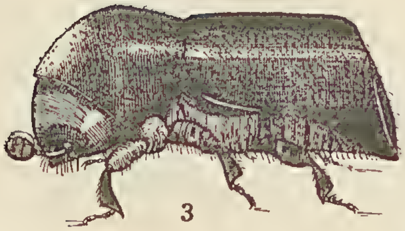
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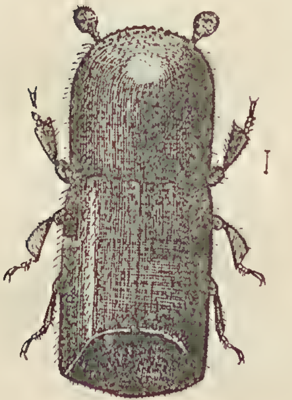
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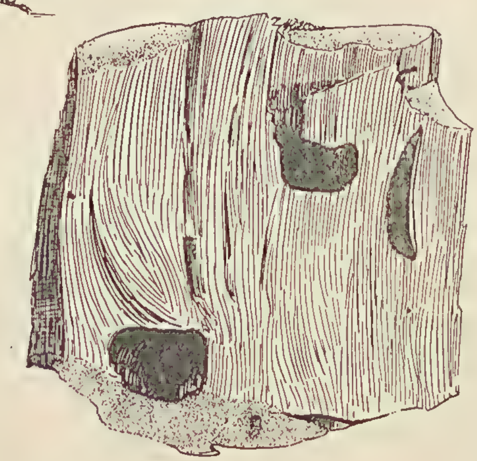
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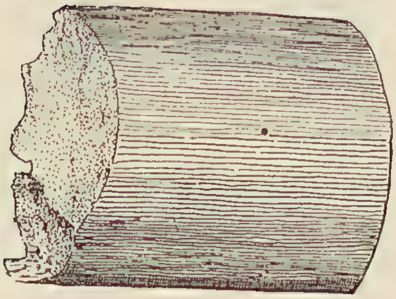
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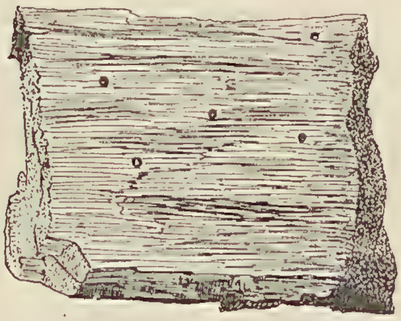
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Life History of the Ridge-tailed Borer (*Amasa truncata*).

1. Larva of *Amasa truncata*.
2. Pupa ,,
3. Lateral view of the beetle.
4. Dorsal view of the beetle.
5. Antennæ of beetle (enlarged).
6. Showing outer surface of damaged wood.
7. Showing section with beetle burrows.
8. Section showing flattened larval chamber below the beetle burrows.

This stem contained active tunnelling beetles but no larvæ or pupæ were in evidence. Sections of the red gum stem from Forbes were carefully cut, so as not to injure the hidden pupal chambers, and brought to Sydney, where in the entomological laboratory of the Forestry Commission they were kept under observation from May until the end of October. In one of these blocks of wood there were three beetles, each of which occupied its own tunnel, in these they rested all day, head downwards, the truncate tip of the body and enfolding wing covers blocking the opening on the surface of the wood.

They were always found in this position when examined in the day time. They were evidently active in the night, for when the tins were opened in the morning the tip of each body was surrounded with a ring of chewed wood. They had brought this refuse wood, excavated in the night, up from beneath, and cast it outside the tunnels, before they took up their regular position guarding the opening.

Should the tip of the body, thus exposed on the wood, be touched with a brush or pencil, the beetle immediately retreated down the tunnel, but when danger was past it returned to its former position.

These three beetles carried on this work for nearly six months. How much longer they would have remained on guard I cannot say, because as soon as the beetles from the pupal chambers in the same block of wood developed and tunnelled their way out the logs were split up to study the internal galleries.

These newly developed beetles were very active towards the end of September. They, after crawling about over the surface of the wood for a day or two, started distinct burrows into the sections of the old log and were soon out of sight.

The larvæ and pupa are so well outlined in Miss King's plate, illustrating this paper, that it is unnecessary to write out a description of these immature forms.

The beetle measures just under $\frac{1}{8}$ of an inch in length. The head, prothorax, legs and undersurface are dark reddish brown, lightly clothed with fine brownish hairs. The wing covers, somewhat darker in tint, are smooth and shining. The rounded head, fitting into the prothorax, is fringed with fine hairs in front of the eyes, but it is smooth behind them. The wing covers and body are rounded on the sides, broadest at the apex, which is sharply truncate. Viewed from above it is almost circular, slightly convex, impressed with fine parallel striæ and fine hairs between them. This ribbed pattern could be easily distinguished with a broad lens when the little beetles were guarding their tunnels.

This interesting little borer was originally described by Erichson in his paper on "The Insects of Van Diemen's Land," which was published in Weighman's Archives, in 1842 (Vol. 1, p. 212). He called it *Tomicus truncatus*, under which name it is listed in Master's Catalogue.

In 1893, Lea published a paper, in the Proceedings of the Linnean Society of New South Wales, in which he re-described this beetle under the name of *Amasa thoracica*. In a later paper in the same journal (1904), "Descriptions of New Species of Australian Coleoptera" he lists *Amasa thoracica*, and says, "This is Erichson's *Tomicus truncatus*, it belongs to the same genus as Eichhoff's *Xyleborus solidus*. He has since reconsidered its classification, and as it does not fit into the generic characterics of *Xyleborus*, its generic name *Amasa* is retained. From my studies on its habits and life history, without considering the structural differences, it should not be included in the genus *Xyleborus*.

It has a wide range through our forests, ranging from Tasmania through Victoria and New South Wales, and will probably be found in the Queensland hardwood forests, though up to date, I have never identified it in any collection of borers from the Northern State. I am indebted to Mr. A. M. Lea for the identification and synonomy ot this beetle.

THE LEAF CASE MOTH.

(*Aceeticus* (*Thyridopteryx*) *hubneri*, Westw.)

This case moth is the most destructive and widely distributed member of the family *Psychidae* in Australia. Most of the other species confine their attention to their native food plants, but nothing comes amiss to the leaf case moth, for it will feed on either native or introduced plants. It is a well-known pest in the Sydney parks and gardens. Many years ago, Olliff, in one of the first entomological papers contributed to the *Agricultural Gazette* of New South Wales, figured and recorded it as a pest to pine trees (1891). In a paper entitled "Australian Case or Bag Moths," in the same journal, I recorded it on oak trees at Parramatta. Under normal forest conditions they feed upon the foliage of the smaller gum trees.

They cover their silken bags with irregular sections of the gnawed leaves; therefore it is somewhat remarkable that they have acquired such a liking for pine needles, for the foliage of a pine tree and a gum tree have nothing in common. With the development of pine plantations all over our State it is becoming a serious forest insect pest. It has shown a special liking for *Pinus insignis,* and as this is one of the introduced pines which is being extensively planted it will have to be protected against these defoliating moth caterpillars.

Spraying will have to be carried out on the plantation, as soon as the first brood appears, otherwise many valuable trees will be killed.

From field investigations made during a recent infestation of the Armidale Forestry Plantation, it is evident that the first generation of this moth fed on the young gum bushes, which have grown up in the plantation since the land had been cleared and planted. From these gum bushes the moths had travelled to the pine trees.

Three generations of these caterpillars have developed since the early part of last year. The abandoned weather-worn cocoons of the first brood are still hanging on a number of the dead pine trees.. The second generation emerged towards the end of last year and were full grown about the end of February. The present (third) infestation consists of the tiny larvæ which have emerged from the mother cocoons. They are forming their tiny shelter caps, and are spreading all over the surrounding trees which were not attacked by the preceding broods.

In going over the plantation this April, I estimated that over 100 pines were dead and twice as many completely defoliated. Since the heavy rains the defoliated pines have recovered sufficiently to start a fresh growth of foliage, but are again at the mercy of the baby larvæ just emerged from the dead mother cocoons. If these trees had not been sprayed they would have died, because these larvæ were eating off the bark of the young branchlets and the immature needles.

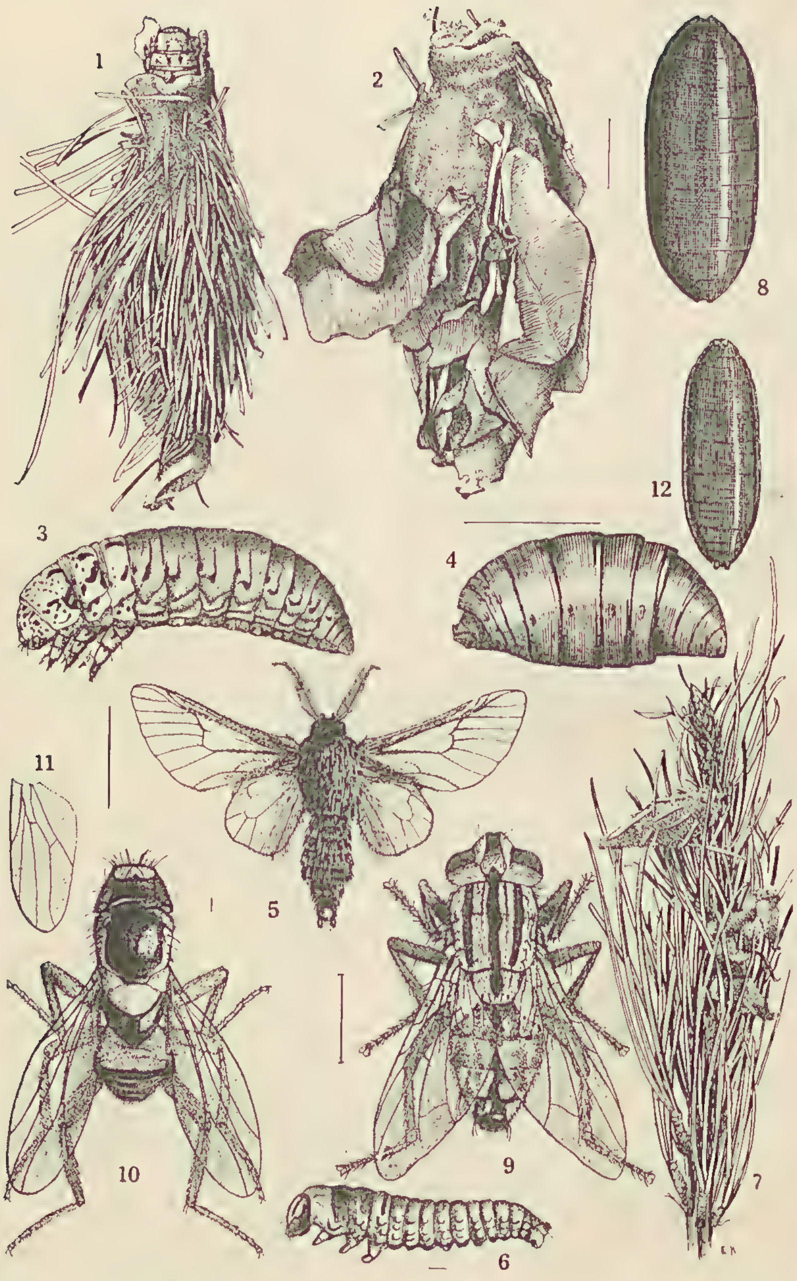
Over a considerable portion of this plantation there were small colonies of case moth cocoons on perfectly uninjured trees; from these cocoons the larvæ were emerging and spreading upward on the branches. From where this movement started branches of dead pine needles stood out from the rest of the green foliage; and on examination they were found to be infested with thousands of baby case moths gnawing the base of the needles and the surface of the branchlets. The caterpillars produced from five adult female cocoons were quite sufficient to defoliate and destroy the branchlets of a well-grown pine tree 10 feet in height. As in most entomological problems, a careful study of the life history of this case moth is necessary to enable one to attack and to destroy the caterpillars at the weakest period of their development.

It is of no use trying to destroy the full-fed case moths by spraying, after they have stopped feeding and are hanging on the trees. Even if practical, hand picking would be too expensive.

The brown silken cocoons covered on the outer surface with pine needles are of similar form in both sexes, except that those of the males are usually smaller. When fully developed each enclosed caterpillar spins a stout pad of silken strands, by which the cocoon is attached to the branchlet and the opening closed at the same time. The tip of the hanging sack frayed to a bare tail is, however, open; and it is through this orifice that the male moth makes his escape from the cocoon. The tiny black larvæ, hanging on a silken thread, drop through a similar orifice in the cocoon of the female.

Though the bags or cocoons of male and female are similar in construction, here the likeness between the sexes ends. After pupation the female simply sheds her larval skin and becomes an oval brown chitoneus body, about an inch in length, encircled with black bands on the lower margins of the abdominal segments. The head is only represented by a wrinkled surface; she has neither legs or antennæ, and the anal portion terminates in rounded knob. She is enveloped in a coating of finely-spun silken strands, which is spun before she pupates, or rather changes her larval skin, for the pupal shell which concludes her incomplete

PLATE XXI.



The Leaf Case Moth. *Aeceticus (Thyridopteryx) hubneri,* Westwood.

1. Larval case covered with pine needles, showing head of larva.
2. Larval case covered with broken gum leaves.
3. Full grown larva removed from case.
4. Female with incomplete development, removed from case.
5. Male moth *Aeceticus* (*Thyridopteryx*) *hubneri.*
6. Small larva before starting to form case.
7. Spray of *Pinus insignis* covered with young larvæ.
8. Puparium of Parasitic Fly (*Sarcophaga*) sp.
9. Parasitic Fly (*Sarcophaga sp.*).
10. Small parasitic fly, *Botanobia sp.*
11. Showing wing of *Botanobia sp.*
12. Puparium of *Botanobia sp.*

metamorphosis. She is now simply a moribund sack of eggs, resting head upward in the suspended cocoon.

The male larva, after he hangs his bag to the twig, turns right round and pupates upside down in his swinging bag. Here he makes a lightning change with the head, eyes, antennæ, wings, and legs perfectly outlined under the chrysolid shell. When ready to emerge the chrysolid works the head and thorax through the opening in the bottom of the suspended sack, the pupal shell splits down the back and the moth flies away, leaving the black chrysolid skin sticking out of the bottom of the empty sack. His business in life is to impregnate the female within her swinging sack. This he is enabled to do through the possession of a slender tapering body, and the opening in the tail of the cocoon. The tiny eggs are closely packed in the body of the female (previously described). In this they hatch, the tiny black larvæ eat their way through shell of the dead mother, and then they drop a wriggling mass of tiny black dots, each with a silken strand attached to the mouth; they drop upon the food plant.

As soon as they reach the plant their rope is abandoned. They crawl about, each spinning a tiny silken cap, which is the base of the future silken case. At first covered with these conical brown caps they are walking about on their heads. They grow rapidly, and as the bag takes shape it becomes an oval silken sack, smooth inside; the outer surface covered with irregular shaped bits of the surrounding food plant. When on the pine trees each little sack is reddish-brown, because it is covered with flakes of the pine tree bark.

The adult caterpillar measures from 1 to 1¼ inches, and is smooth and somewhat cylindrical in form. The general colour dark brown to almost black, but the head, thoracic segments and legs are creamy white, mottled with light brown. It moves about very easily, the mode of progression is by means of the head and first two pair of legs, which are extended beyond the neck of the case; the hind pair of legs and the inner prolegs clinging firmly to the inner surface of the case. When disturbed it withdraws the whole of the head and legs within the case, and clings to the interior when one tries to remove it from its shelter.

The male moth measures about an inch across the outspread wings; the head and body about half an inch. The dark yellow antennæ standing out in front of the head are delicately feathered. The head, thorax, legs, and body clothed with long, black hairs; these extend on to the base of the wings, the nervures being marked with fine hairs, but the rest of the wings are clear and transparent.

Method of Destruction.—At this last outbreak at the Armidale State Forest Plantation I have demonstrated that if the infested pine trees are sprayed at the proper time, when all the baby larvæ have spun their little caps and are busy eating the foliage and gnawing the bark of the branchlets, the pest can be overcome.

The arsenical spray kills the grubs by contact, and also by depositing poison on the surface of their food plant. Trees swarming with these larvæ in the morning were sprayed. Next morning I inspected these sprayed trees, and collected and opened a large number of these little caps. In every case the inmates were dead. The spraying material selected was arsenite of soda, and the quantity used was one pound of arsenite of soda to each 25 gallons of water. Probably a somewhat weaker solution would be effective, and experiments to be carried out will show how much water can be used to reduce the cost, and still kill the case moths. With a modern spraying plant and arsenite of soda spray all leaf-eating pests can certainly be kept in check at a cost which will pay the Commission.

Parasites.—Though apparently well protected from enemies during their larval development in their silken bags, this moth is destroyed by at least four distinct dipterous parasites, some of which play an important part in the control of this defoliating moth.

Sarcophaga sp.—This fly has the head and sides of the thorax, behind the eyes, clothed with golden pubescence. The dorsal surface of the thorax and pronotum silvery grey, marked with three parallel black lines, the central one extending across the centre of the pronotum. The wings semi-opaque, with black nervures; the legs clothed with black bristles; the abdomen black, mottled with silvery grey, and the whole clothed with fine bristles and downy hairs; length, 2-5th inch. Usually only one fly pupa was found in the case, but in some instances two fly pupæ were found with the remains of the moth caterpillar.

Tachina sp. 3.—This parasite has the head clothed with silvery pubescence interspersed with black bristles, and a line of very fine black bristles round the back of the head behind the eyes. The upper surface of the thorax and pronotum grey with a brownish tint, the former crossed with four irregular black lines running from the front margin, but not reaching the hind margin; pronotum plain. The basal portion of the abdomen black, second segment silvery grey with hind margin black, the whole clothed with stiff black bristle, which stand out in a row on the hind margin of the third abdominal segment.

Tachina sp. 2.—This is the largest species, variable in size, the largest ½ an inch in length. The head and thorax is of a uniform slate colour; the pubescence on the head silvery; the thorax marked with short black impressed lines; the pronotum smooth, shining, light chocolate brown, clothed with fine hairs, the sides of the thorax clothed with fine hairs and bristles. Abdomen black, mottled on the upper surface with silvery pubescence, clothed with fine black hairs, with the apical portion thickly interspersed with stout bristles.

Botanobia sp.—In one cocoon a number of tiny fly maggots were found on the dead moth pupa, which later pupated and emerged. These handsome little shining black and yellow flies measured 1-10th of an inch in length. The front of the head is light yellow, the hind portion and the dorsal surface of the thorax shining black, and the two last segments of the abdomen marked with black; the legs, pronotum and rest of the body yellow. This fly belongs to the family *Chloropidae* and probably comes in the genus *Botanobia*.

POWDER-POST BEETLES OF THE FAMILY LYCTIDÆ.

A GOOD deal of attention has been paid to the members of the Family *Lyctidae* during the last few years, due to the altered conditions of the timber trade in holding big stocks of seasoning timber, the sapwood of which becomes infested by these timber beetles.

The popular name of "Powder-post Beetles" was given to the members of the Family *Lyctidae* by the economic entomologists of the United States. Although this name defines the damage caused by the beetles it has never been quite satisfactory. In the last bulletin issued by the United States Bureau of Entomology, the author defines them much better as "*Lyctus* Powder-post Beetles."

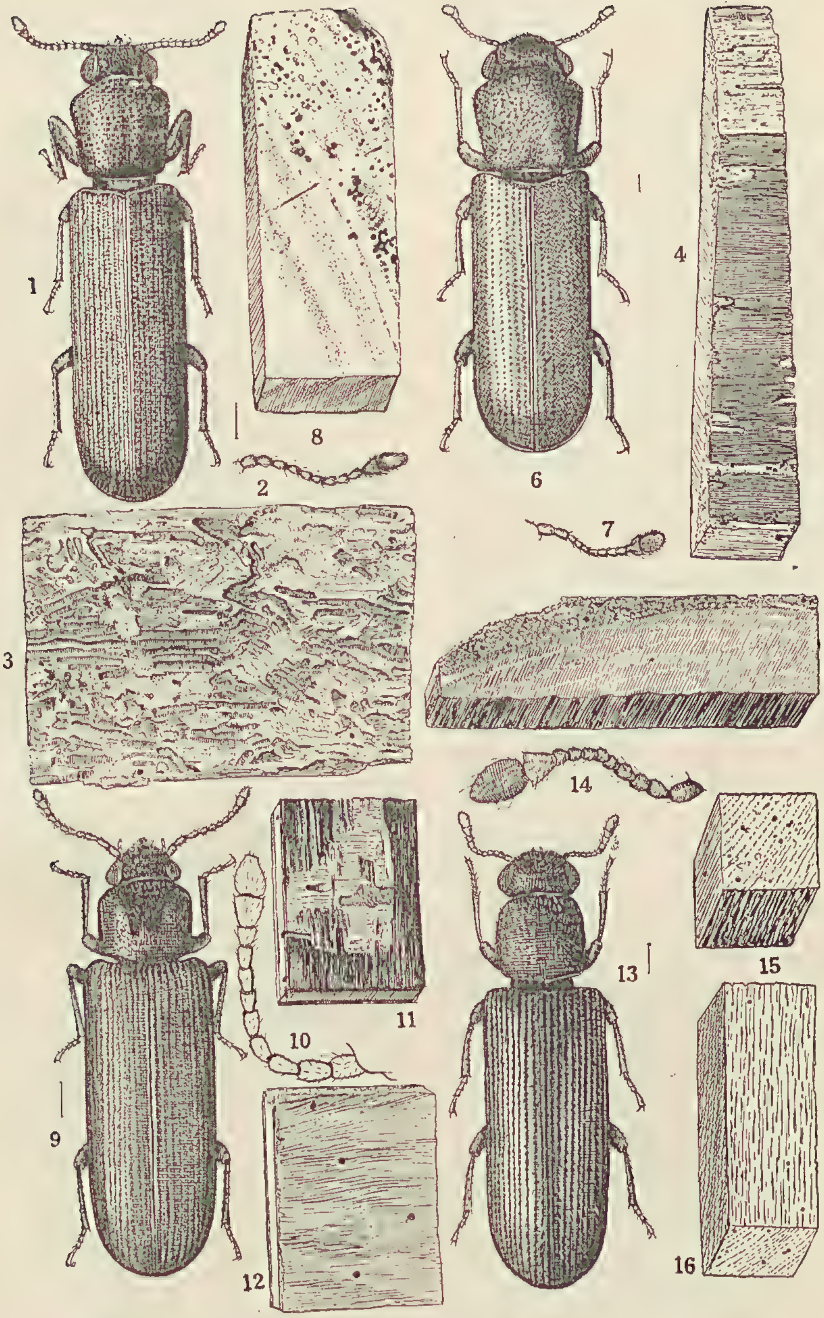
Broadly speaking, these beetles confine their attention to the sapwood of our Australian hardwoods, but in other countries many of the Bostrychid beetles attack sapwood also. Many kinds of seasoning timber may become infested with these borers if they contain sapwood, even if the sapwood be perfectly free when stacked in the timber yard.

There is hardly a timber yard or sawmill in New South Wales which does not contain waste timber of some sort harbouring *Lyctus* beetles. These emerging in midsummer fly to the adjacent stacks. If the condition of the sawn timber is suitable, that is, if it has been felled six or eight months, the beetles deposit their eggs in the pores of the sapwood. In doing this they leave no outward evidence of their presence, until months later, the beetles developed from these eggs, cut their way out, leaving their flight holes on the surface with its tell-tale heaps of wood dust round the openings.

During the last two years we have carried out some important investigations under ordinary sawmill conditions concerning the life-history of our commonest species, *Lyctus brunneus*, and on the protection of seasoning timber. A report of this interesting experimental work has already been published in the Journal of Forestry.

Through the courtesy of the managing director of the Brooklana Timber Company, I was able to carry out these tests under ideal conditions. As the timber of the "Crab-apple" or "Australian elm," *Schizomeria ovata*, which has been long known as a fine furniture wood contains a considerable percentage of sapwood and usually becomes infested with powder-post beetles, when kept for any length of time, it was selected as a suitable tree for experimental purposes. These investigations were commenced on the 15th February, 1924. The logs were cut in the forest, and drawn in to the mill. Here they were immediately cut up on the saw bench, carried out and stacked on a

PLATE XXII.



Life History of the Powder-post Beetle of the Family *Lyctidæ*.

1. *Lyctus brunneus.*
2. Antennæ *L. brunneus.*
3. Section of Stavewood showing parallel galleries of *L. brunneus.*
4. Tasmanian stringybark showing parallel galleries of *L. brunneus.*
5. Tasmanian stringybark showing transverse galleries of *L. brunneus.*
6. *Lyctus costatus.* 7. Antennæ of *L. costatus.*
8. Cross-section of Alpine gum showing damage by *L. costatus.*
9. *Lyctus caniculatus.* 10. Antennæ of *L. caniculatus.*
11. Three-ply wood, surface removed to show damage by *L. caniculatus.*
12. Three-ply wood showing flight holes of *L. caniculatus.*
13. *Lyctus sinensis.* 14. Antennæ of *L. sinensis.*
15. Cross-section of Japanese oak showing damage by *L. sinensis.*
16. Parallel section of Japanese oak damaged by *L. sinensis.*

platform in the open. Eight stacks were made, each separated from the other by a couple of feet, all exposed to wind, rain, and sun.

This sawn timber was of various sizes with an average of an inch thick. No sapwood was cut off the sawn timber, except that attached to the outer margin of the log when squared on the saw bench.

Seven different oils and mixtures were used for treatment: 1. Deerman's antiantine, a creosote mixture; 2. A distillate oil stocked at the mill; 3. Bone oil, obtained from the Colonial Sugar Company. These mixtures were not treated, but were brushed or sprayed over each board or batten as it was stacked. The other four mixtures were heated; and were sprayed or brushed on while hot. They were as follows :—4. Kerosene emulsion combined with arsenical solution; 5. Distillate oil, resin oil, and arsenical solution; 6. Silverton, and oil and creosote, a proprietary mixture; 7. Gas Company's creosote. Each board was distinctly marked. A similar stack of untreated timber was placed beside as a control. I paid several visits to Brooklana; and the stacks were under observation until October, 1925. As a second control, a large crab-apple tree was felled in the adjacent forest, cut up into logs. Some of the logs were barked; others were left with their bark on. Half of the logs were treated with creosote or arsenical mixture, the others were untreated.

A close inspection was made in the forest of all fallen trees or cut logs of crab-apple, but we found no signs of *Lyctus* beetles in any of such logs under forest conditions. As no beetles infested any of the treated or untreated logs in the forest, infestation is apparently confined to the vicinity of the sawmill yards. Though no *Lyctus* beetles were noticed about the Brooklana mill yards they must have wintered in some waste wood. At Megan, however, I examined a stack of rejected crab-apple timber which had been stacked in the mill yard for over two years, and there I found that all the sapwood of the stack was damaged and infested with live *Lyctus* beetles and larvae. The experimental stacks at Brooklana remained undisturbed until 21st October, 1925. We then went over each stack. We cut off two feet lengths of boards and battens, and split each up. Each bit was carefully examined for larvae or beetles. No evidence of life was found in any of the sections cut up taken from treated stacks. But as soon as we opened out the wood in the untreated stack, we found living larvae at work in every section containing any sapwood. As these larvae were nearly full fed, and in several cases pupae and immature beetles were exposed in the burrows, the infestation must have taken place nearly twelve months previously.

A second series of sections were cut out of the stacks, planed at the mill, and brought down to the Forestry Commission. Up to the present time, 20th July, 1926, all the treated timber has remained intact, though exposed to infestation from the many *Lyctus* beetles which emerged from other timber samples during the last summer.

On the other hand, the untreated sections which have been also kept under observation show a very heavy infestation. Throughout the summer three of these sections of untreated timber 15½ inches in length, 3 inches in width, and 1 inch thick, were examined every morning and the date of the flight holes was marked upon the wood.

The first beetle emerged on 3rd of December and at the end of the month eighteen flight holes were marked off. In January fifty-nine more beetles cut their way out; in the month of February twenty-nine beetles emerged. In March the numbers decreased to fifteen flight holes. A total of 121 beetles emerged in the four summer months.

Thus far, our investigations show that the infestation of the sapwood of Australian timbers does not take place until the wood has been partially seasoned. This is about eight months after the logs have been sawn up. Therefore it is not necessary to treat sapwood timber immediately it leaves the saw bench, though probably that would be the most economical time to deal with it before stacking.

Under Australian conditions I have never found *Lyctus* beetles infesting any portion of the heartwood of our Eucalypts. The injury is confined to the sapwood. The division between the heartwood and sapwood is as clearly marked off by the beetles as if it had been outlined with a pencil. The colour, the texture, and the amount of sapwood varies very much in the different species of hardwoods, so that it is often very difficult even for a timber expert to define the exact division between the two but the margin of the *Lyctus* infestatio can be taken as an infallible guide.

In our other brush timbers this rule also applies; few of these timbers are exempt; a very close observer, who has had a very large experience among furniture timbers, showed me a stack of Red Cedar, milled in Sydney, where the *Lyctus* had infested the sapwood after the timber had been stacked about four months.

Large shipments of Red Louan or Pacific Maple timber come to Sydney from the East, the Philippines and Borneo being the chief centres of export. This timber is sometimes lightly infested with a native species of powder-post beetle (*Minthea rugicollis*). When this timber is stacked for any length of time in a Sydney timber yard, it frequently becomes infested by the common cosmopolitan species (*Lyctus brunneus*).

From some sawn Japanese oak landed in Sydney two years ago I bred out of the sapwood several specimens of a Japanese species of powder-post beetle (*Lyctus sinensis*).

Last year I received a 3-ply board composed of American wood and Queensland maple, it had been made up at the Kyogle Veneering Works and sent to Victoria, where it had been with other wood made into a dressing table. Only one portion of this board had been perforated with the flight holes of about a dozen beetles. Some of the escaping beetles were captured and sent with the wood. They proved to be a European species (*Lyctus caniculatus*) which Lea has recorded from Tasmania and Victoria. In the United States Bulletin previously noted, Snyder gave an illustration of a similar 3-ply board damaged by the American species (*Lyctus planicollis*).

The United States authorities, in the Bulletin previously noted, recommend the annual turning over of all stacks of sawn timber, between the months of October and March; the destruction of all badly infested pieces, and the treatment of the lightly infested wood with kerosene oil or orthodichlorobenzene. I suggested that if the site of the stacks and platforms were sprayed with creosote in the first case, and the outer surface of the completed timber stacks were sprayed with crude oil or creosote mixture they would be immune from the infestation of the beetles looking for timber into which they poke their eggs.

An up-to-date spraying plant will become before long an important adjunct to every timber yard where large stocks of sawn timber are held for any length of time. The proper manipulation of the spray pump will be the means of protecting and saving much high-class timber from deterioration; from not only insect depredations but from damage by fungus and dry rot.

Scattering sawdust which has been moistened with carbolic solution among the layers of timber as the stack is being built will keep pin-hole beetles away, and should have the same effect upon powder-post beetles.

At the sawmill where timber subject to *Lyctus* beetles is being cut regularly, although not necessary to treat the freshly sawn board at once, it would save extra handling to dip it as it left the saw bench into the protective fluid.

A simple and inexpensive metal or wooden trough could be constructed at the end of the carrying benches, and the timber cut to size, slid along in the liquid, which could be treated by steam from the engine. As the treated timber moved along the trough it could be mechanically upended, allowed to drain on a sloping floor, so that the surplus fluid ran back into the trough, and then dropped over on to the waiting trolly.

We found that none of the mixtures we used at Brooklana, not even crude creosote, left any lasting stain on the surface of the treated wood; it had weathered off in the stack. The planing machine removed the last traces.

This simplifies the matter of protecting sapwood, for any oil or creosote or combination of both will answer the purpose, and it is not necessary to combine mineral poisons in the liquids, if the latter close the pores of the wood against the beetles.

This knowledge we have gained, that *Lyctus* beetles do not deposit their eggs in sawn timber until it has been exposed for at least six months. Snyder says, writing of North American conditions, "Sapwood seasoned for less than eight or ten months will not be attacked." We are still better able to control the borers. To prevent attack the same writer says, "Treat the more valuable timbers between October and March with boiled linseed oil. Varnish or paraffin the sapwood portions of backs and interior surfaces of cabinet work, inside finish, and furniture. Stock which has been submerged in water for four months or longer will not be liable to attack."

The most active emergence time of the beetles in New South Wales has been previously noted—from December to the end of

March. Kiln-drying of sapwood timbers has been advocated by some authorities as a solution for powder-post beetle infestation; and it has been claimed that the action of heat and steam so applied alters the conditions of the wood fibre so that it is distasteful to the beetles.

Mr. M. B. Welch, of the Technological Museum, has recorded some interesting facts in the Journal of the Royal Society of New South Wales, 1923, regarding the amount of moist heat required to kill insect life in timber, and how long it takes to kill them. There is room for a large series of experiments in this direction. We want to know something about the immunity of our various timbers from outside attack of any timber-boring beetles after treatment in the kiln.

Where untreated hardwood is being used for floors, rafters, joists, wall-plates and battens in any part of the building, it would not be difficult to treat any marginal sapwoods, when they are cut, and being placed in position. It would certainly be a guarantee for the owner, if when the hardwood floors are laid each edge was painted with creosote by the carpenter.

It may appear to the general public, that the most simple way of overcoming the damage caused by *Lyctus* beetles, as they only attack sapwood, would be for the sawmillers to cut off all the sapwood. Not only is it the business of the timber getter and timber merchant to get every foot of sound timber out of the log, but it must be remembered that there is a very large percentage of sapwood in some of our hardwoods and brush timbers which is as stout and strong when seasoned in combination with the heartwood as the inner heartwood itself. In mountain ash and some of the smaller gums there may be as much as 30 per cent. of the log sapwood of perfect texture. Other of our valuable brush timbers come in the same class. To be profitably milled it must be cut up in the squared log on the saw bench, sapwood included. Hence the importance and value of these suggested protective measures.

Our hardwoods, such as Tallow-wood (*Eucalyptus microcorys*) Stringybark, (*E. capitellata*), Messmate (*E. obliqua*), and many others when properly cut and seasoned make perfect and lasting floors, and are largely used in Australia. The owners of houses, flats, and warehouses frequently find towa ds midsummer little patches of wood-dust along the margins of the boards. When the rooms have become unoccupied and the linoleums and floor cloths removed for a time, this may become very noticeable; the line of wood-dust may extend for yards parallel with the margins of the floor boards. The owner is naturally alarmed at this evidence of borers, and he frequently when investigating the matter sees old holes of pin-hole borers which have been in the joists or rafters when the house was built and contain nothing alive. He thoroughly frightens himself, and at this stage calls in the expert who advertises a certain cure for borers and white ants. If he is wise, however, he will consult his architect or a reliable builder, who, with a few gallons of creosote and kerosene mixed, or the latter alone in the living rooms, will check the damage and kill the borers, unless the timber is of a very inferior quality, and very badly infested. In very few cases is it necessary to renew the boards if it is only powder-post beetle infestation.

Life Histories.—The description and method of disposition of the eggs in the pores of the sapwood, and the life histories of several species of *Lyctus* beetles have been fully worked. In the Journal of Agriculture, Washington, United States of America, 1916, Snyder published a paper entitled, "Egg and manner of disposition of *Lyctus planicollis*." In this paper he describes and figures the elongate cylindrical egg, with the curious striated base and tail or filament. Egg-laying takes place in the United States in the middle of May; the first larvae being observed a fortnight later. The winter is passed in the larval stage, and they pupate in April, before pupating the full-grown larvae burrowing transversely nearly to the surface, so that the emerging beetle has only a short distance to cut its way out from the end of the pupal chamber.

In the Journal of the Linnean Society, London, 1923, Alston contributes an article "On the method of oviposition and the eggs of *Lyctus brunneus*." In this paper he describes the egg of this species as very similar to the common North American species. He states that the *Lyctus brunneus* and *L. linearis* are the two common species in Britain. Hopkins considers that *Lyctus brunneus*, though now cosmopolitan in its range, originally came in timber from South America, and that *Lyctus linearis* is a native of Europe. Kraus and Hopkins in their "Revision of the Powder-post Beetles of the Family *Lyctidæ* of the United States and, Europe 1911," list all the known species up to that date. Besides the cosmopolitan *Lyctus brunneus*, which is certainly the commonest species in our timber yards, Blackburn has described three other species as peculiar to Australia.

The damage caused by the larvae of the *Lyctidæ* can always be distinguished from that of the other timber-boring beetle larvae, because they usually follow the pores in the parallel tissue of the wood, with short galleries on the sides, all of which are solidly packed with wood-dust, as they feed along through the sapwood. In some woods the damage varies. Where the parallel cells and wood fibre are very open these galleries, as shown in the illustration of Stavewood (*Tarrietia actinophylla*) is a good example. Here the infestation has been so heavy that the galleries run into each other and the cross fibre of the wood is all eaten away.

It is stated by Alston that virtually blind, they have the power of recognising when they are approaching the surface of the wood, an instinctive habit shared by many timber-borers. Therefore, all the holes in the surface of the wood, the first outward indication of the infestation of the timber, are the-flight-holes" made by the perfect beetles when they cut their way out. Sometimes a larger patch of wood-dust may be noticed on the surface of the wood; this is the work of a Clerid beetle parasite (*Paratellus carius*), which kicks out the dust while hunting for the larvae of the powder post beetle, upon which he feeds.

Species of the Family Lyctidae recorded from, or Natives of Australia.—The following species, briefly described, are introduced species which have been cut or bred out of wood, more or less established in Australia, or natives of our forests, or native species.

Lyctus brunneus Stephens (Illustrations of British Entomology, 1827).

This species has a world-wide distribution, and is our largest common species found in all kinds of sapwood timber.

Its length varies from $\frac{1}{5}$ to $\frac{1}{10}$ of an inch. It is of a uniform dark reddish brown colour. The head is short and broad; the large rounded eyes project on the sides; the last two segments of the antennae form a flattened club. The prothorax overhangs the back of the head; is rounded in front, swelling out on the sides behind the eyes; then arcuate, and rounded on the hind margin. The dorsal surface convex, not shining, covered with fine shallow punctures and lightly clothed with short scattered hairs. Body and wing covers long, of uniform width, the latter bearing very shallow parallel striae, small irregular punctures, and scattered long recumbent brownish hairs.

Lyctus costatus Blackburn (Trans. Royal Society of South Australia, p. 265, 1887).

A single specimen of this species was taken at Port Lincoln, South Australia, by Blackburn. He says: " Larger than *L. brunneus*, much less shining, differently coloured, the prothorax more coarsely punctured, and more noticeably at its widest in front; the elytra much more obscurely punctured, and with the raised interstices very much more conspicuous.

I have a large series bred out from the wood of Mountain ash (*Eucalyptus gigantea*) which, except for their smaller size, appear to agree with Blackburn's description of this species. The timber had been stacked for two years in a mill yard at Batlow, New South Wales. The beetles bred out in January.

These specimens are of a uniform dull brown, clothed with fine hairs, and not shining.

Lyctus discedens Blackburn (Trans. Royal Society of South Australia, p. 267, 1887).

This species was also described by Blackburn from the Port Lincoln district, where they were taken under the dead bark of eucalypts.

It is a smaller species than *Lyctus brunneus*, of a uniform reddish brown tint. Head and thorax smooth and shining, very finely punctured. Prothorax rounded and not projecting behind the eyes, or sloping on the sides.

Blackburn says: " A very shining species, almost devoid of pubescence. The head and thorax finely and not at all closely punctured, otherwise resembling the same parts of *L. costatus*. The punctures of the elytral rows are extremely fine, scarcely discernible near the striae. The interstices smooth and shining, and quite flat except on the hinder part of the disc, where they are scarcely convex.

" My specimens came from the same locality and timber as those of the previous species."

Lyctus parallelocollis Blackburn (Trans. Royal Society of South Australia, p. 266, 1887).

I have one specimen which comes from Mackay, Queensland, which may be identical with Blackburn's species. It has the sides of the prothorax perfectly straight, but it does not quite agree with the author's description.

Blackburn says: "More shining and less pubescent than *L. costatus*. Head and thorax very strongly, but not closely, punctured. The latter transverse, its front margin strongly convex, its sides nearly straight, the hinder portion of the disc widely flattened. The elytra are distinctly striated, the striae being strongly punctured, the sculpture best defined on the disc, where and towards the apex the interstices have a tendency to be convex."

The type specimens were also collected under dead bark in the Port Lincoln district.

Lyctus caniculatus Fabricus (Syst. Ent., 1775).

This species according to the latest authorities is identical with *L. linearis* Goeze; *L. oblongus* Step.; *L. striatus* Melsh.; and *L. unipunctatus* Herbst.

Early last year I received several specimens of this species which had been captured when emerging from their flight holes in a 3-ply board composed of some soft timber faced with veneered Queensland maple. This board had been part of a parcel of timber, made up into the back of a dressing table. There were a dozen circular holes on the polished surface of the board.

This beetle measures $\frac{1}{5}$ of an inch. It is of a uniform dark brown colour clothed with scattered yellowish hairs extending over the antennae as well as the head and thorax, those on the wing covers following the parallel striae. The head prominent, eyes large; antennae long with the apical segment heart-shaped. The thorax is finely punctured, rounded on front, sloping on the sides to the hind margin, with a depression in the centre of the dorsal surface. The body broad, with the wing covers somewhat flattened.

This is a European species, and has been previously recorded from Tasmania and Victoria by Lea under the name of *L. oblongus*. In 1862 Noerdlinger recorded this species infesting both hardwood and sapwood of the black locust tree (*Gleditschia triacanthos*).

Lyctus sinensis, Lesne.

Several specimens of this species were bred out of the sapwood of some sawn Japanese oak taken from a shipment landed in Sydney in 1924. The larvæ were burrowing through the wood in a more irregular manner than is usually the case with these borers; but this was probably because of the structure of the pores of the dry timber.

The beetle measures about one-eight of an inch. The head and thorax are dark brown; the wing covers light yellowish brown in the centre, with the outer edges brown. The head is clothed with fine white hairs; the antennæ are long, and terminate in a large club. The thorax is long, clothed with fine hairs, obscuring the punctures, rounded in front, sloping slightly on the sides to the hind margin. The wing covers are clothed with grey hairs on the front margin, the dorsal surface finely reticulated and the parallel striæ shallow.

Minthea rugicollis, Walker.

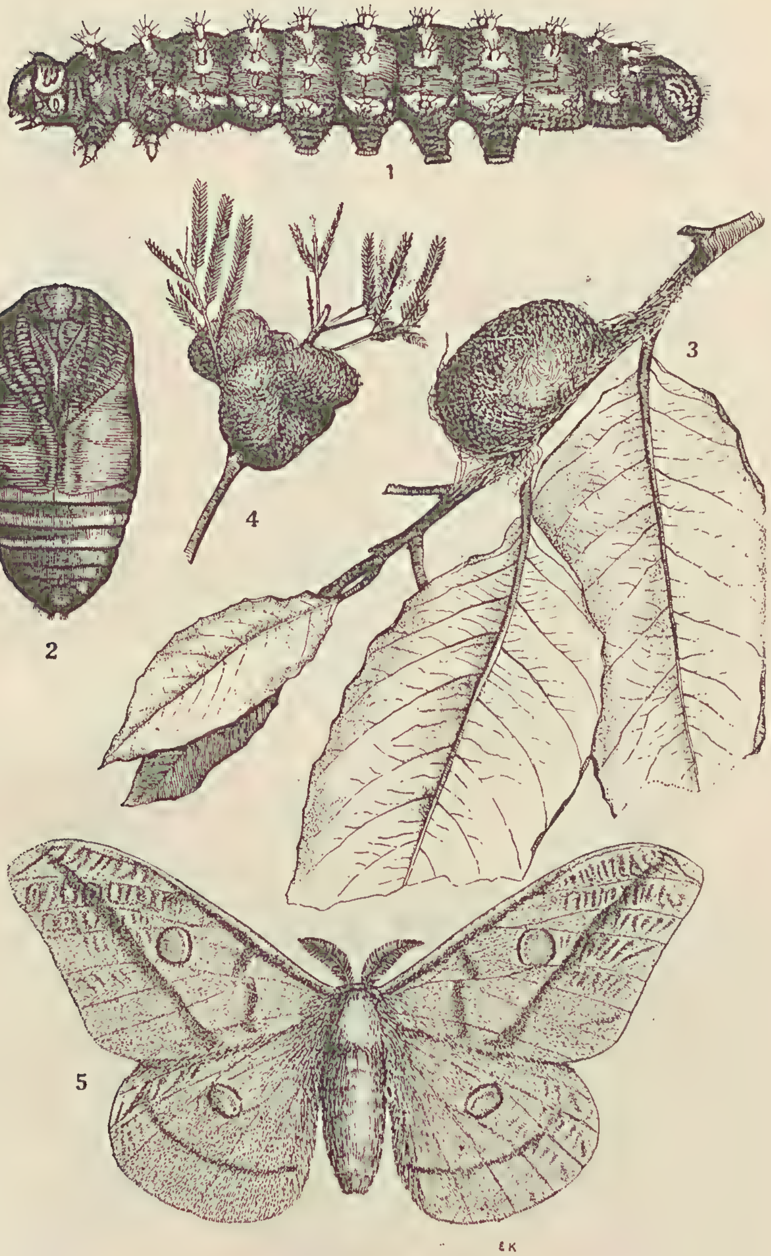
This curious beetle with the whole of the dorsal surface covered with short erect yellow filaments, is found in the sapwood of sawn Red Lauan timber coming from the Philippines. I have taken a number of live beetles from logs when splitting them up for timber borers. It is figured and described on page 20 of this publication under the name of *Lyctopholis rugicollis*.

THE YELLOW SILKWORM MOTH.

(*Antheraea simplex*, Walker.)

THIS handsome wild silkworm moth was originally described by Walker in the British Museum Catalogue of Lepidoptera, published in 1855. He described the male and female under different specific names, calling the female *Antheraea astrophela* and the male *Antheraea simplex*. Scott, in his work, "Australian Lepidoptera and their Transformations," published in parts by the Trustees of the Australian Museum (vol. ii, part 2; plate xiii, 1891), describes this moth, and illustrates its life history with a fine coloured plate. He records the gregarious habits of the caterpillars, and states that their favourite food plants in the lower Hunter River brushes are the Native Ash (*Elæocarpus obovatus*) and the Brown pine (*Podocarpus elata*).

PLATE XXIII.



Life History of the Yellow Silkworm Moth.

Antheraea simplex.

1. Larva of *Antheraea simplex.*
2. Pupa of *Antheraea simplex.*
3. Cocoon of *Antheraea simplex* on food plant.
4. Group of cocoons on wattle foliage.
5. *Antheraea simplex.*

The first time I found these caterpillars at work was at the Agricultural Experiment Farm at Grafton, on the Clarence River. There they were defoliating one of our good brush timber trees, the Red Ash (*Alphitonia excelsa*). I collected a large number of the cocoons and placed them in the Insectarium in Sydney, but only a small percentage of moths emerged, as the pupæ were very heavily parasitised by an Ichneumon wasp.

Early last May (1926) Mr. A. A. Gollan, Superintendent of the Gosford State Nursery, sent me word that he had found a large Red Ash near the nursery, which was covered with large black caterpillars. Later on he sent me a large box of them; all the caterpillars were full grown and had spun their cocoons, and pupated before the middle of the month. I visited the district and found this tree completely defoliated, while other Red Ash trees in the surrounding forest had been more or less damaged. After devouring all the foliage, while some of them spun their cocoons on the leafless twigs, most of the caterpillars travelled down the trunk and scattered over the bracken ferns, small wattle and leptospermum shrubs, spinning their cocoons in less conspicuous situations under the tree. These caterpillars, like all the other species belonging to the genus *Antheraea,* are large, handsome creatures clothed with rows of brightly-coloured tubercules. When full-grown it measures from 2½ to 3 inches. It is of a uniform velvety black tint, with the legs and mouth parts reddish-brown; the whole of the dorsal surface, behind the head, is ornamented with transverse rows of slender cylindrical pale yellow tubercules, terminating in little rosettes composed of six white filaments. Upon the first thoracic segment there is only one on either side; on the second and third thoracic segments there are six; and the same number is present on the following seven abdominal segments; on the eighth abdominal segment the number is the same, but the central one is double; on the terminal segment they are reduced to four, with the stout anal claspers turned down beneath. Each of the tubercules is surrounded at the base with a patch of bright yellow; on the sides of the body there is a stripe of light green between them. The under-surface of the caterpillar is clothed with scattered white hairs. Scott states that the young larvæ before the first moult are black with segmental whorls of white hairs, which, after moulting, are replaced with the large tubercules. He also says that there are usually two broods of moths every year, the summer one in January and February, and the spring one in October and September.

The cocoons are composed of fine buff or light biscuit-brown coloured silken strands; they average about an inch in length, and are half an inch in diameter, broadly rounded at the ends. The cocoons are compact, but very thin, somewhat rough on the outside, but smooth and shining on the inner surface.

The enclosed pupæ are dark reddish-brown, short and thick-set in proportion to their length, rounded at the extremities, and slightly constricted on the sides at the junction of the thorax with the abdominal segments. The divisions between the segments are well defined; the fifth to seventh deeply contracted and mobile, the anal segment sounded, slightly roughtened and furnished at the tip with a tuft of six outwardly-curved bristles on either side. Length, nine-tenths of an inch; diameter, ½ inch.

SHOT-HOLE BORERS.

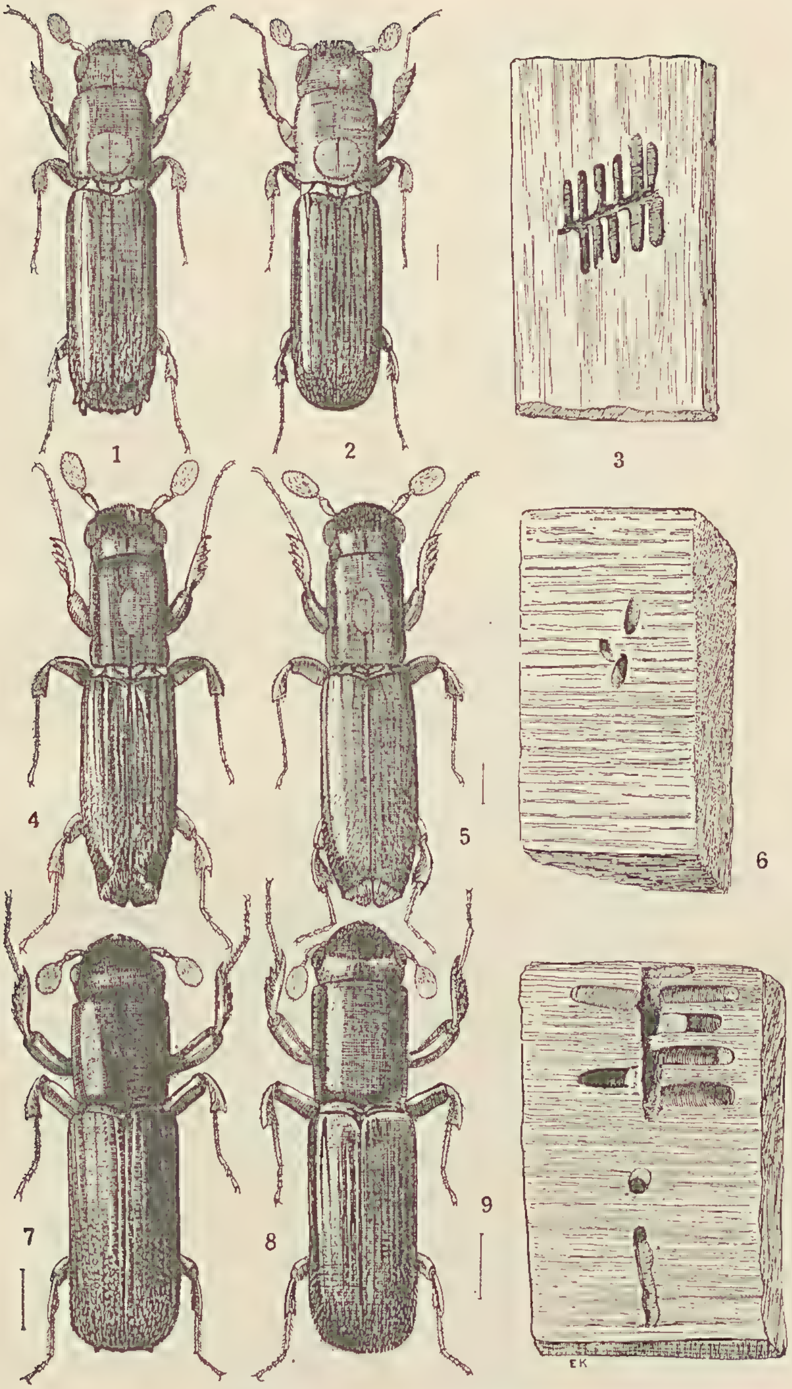
(*Ambrosia* Beetles, belonging to the Genus *Platypus.*)

The Genus *Platypus* was formed by Herbst in 1793. It is composed of the two Greek words, meaning "broad foot." It is interesting to note that when "Duck-bill Platypus" was first discovered, its describer gave it the generic name of *Platypus* on account of the form of its feet. Later investigations showed that Herbst had used the name first, so this genus of beetles retained the name Platypus and the zoologists had to find a new name for the animal and gave it the very appropriate one of *Ornithorynchus,* "duck bill."

The French naturalist F. Chapius published his "Monographie des Platypides" in 1866, in which he listed 157 species, many of the previously unknown. Among them were three from Australia (Memoires Royal Society, Liege, Vol. xx, 1866).

According to Hopkin's Classification the Family *Platypodidæ* is placed as the last of the four subdivisions of the Super-family *Scolytoidæ.* On the other hand Swain, in

PLATE XXIV.



Shot-hole Borers (*Ambrosia Beetles*).

Belonging to the ***Genus Platypus.***

1. *Platypus omnivorus*, Lea, male.
2. „ „ female.
3. Cradle galleries of pupæ.
4. *Platypus australis*, Chapius, male.
5. „ „ female.
6. Cross galleries of the pupæ.
7. *Platypus froggatti*, Sampson, male.
8. „ „ female.
9. Cradle galleries of the pupæ.

his "Canadian Bark Beetles," 1918, places the Genus *Platypus* in the Super-family *Ipoidea,* in the Family *Platypodidæ* following the Family *Ipidæ.*

The family is fairly well represented in Australia and New Zealand, true semi-tropical borers, they are chiefly confined to the coastal brush forests, though they sometimes attack the dying hardwoods. Though odd specimens may be captured in the forest, attracted to a light, the most satisfactory method of collecting these beetles is by chopping them out of their galleries in infested trees, and obtaining a good series of both sexes. As the males and females of the same species vary in form in the sexes, the males and female have been described in many instances by writers as distinct species when dealing with Museum material. The members of the Genus *Platypus* are a very interesting group of timber-boring beetles, which, with several other genera of the family, are known as "Ambrosia Beetles," because though the beetles chiefly, and their larvæ to a certain extent, bore into green timber, they do not feed upon the gnawed wood, but upon the exuding fermenting sap, which forms a skin or film upon the surface of the galleries they excavate. Their activities also generate a fumagine or black fungus, so that later on the galleries through the wood become black. An excessive production of sugary sap and resultant fumagine often fill the galleries and smother the larvæ and beetles working in them.

In the summer months these beetles are attracted to freshly-cut logs both in the forest and sawmill yards, when resting upon the surface of both unbarked and barked logs they bore vertical shafts down through the sapwood for several inches before they commence their transverse galleries, and finally construct their characteristic larval cradles. These oval chambers are excavated in double rows on each side of the parallel gallery, four or five cradles on either side in which the full-fed larvæ have fed and pupate, each chamber sealed up on the gallery with a plug of bee-bread like material.

The beetles may bore into stumps left by the timber-getters, and are common in fallen trees in the forest before the sap has dried out of the timber, and also in standing trees which have been injured by forest fires.

Their presence is easily noticed by the accumulated castings surrounding the vertical shaft through the bark, or strings of castings sticking out of the shot holes in the injured tree trunks.

The different species vary somewhat in their habits. The beetles when once they get their heads buried in the bark or sapwood, soon burrow out of sight. Though the beetles do the greater part of the boring, I have found the larvæ in sawn boards cut off an infested log, move about in the burrows cut through by the saw, and are very active. Some under observation used to move up and down such chambers, and in the morning there would be a regular ring of chewed wood round the opening which had been pushed out of the gallery during the night. The almost cylindrical larvæ are dull white in colour, furnished with stout black jaws, no legs, but the undersurface of the thorax and abdominal segments furnished with small projecting bosses, which, by the contraction of the segments enable the larvæ to move up and down the galleries. The dorsal surface of the thorax, in all the species I have examined, is ornamented with a pair of oval markings joined together by a curved loop like the outlines of a pair of spectacles.

The pupæ resting in the cradle chambers soft and rounded look like a row of swathed up mummies. The illustrations in the accompanying plate show the characteristic structure of the cradle chambers, at right-angles to the leading gallery, of three of our species, and it will be seen that the alternate chambers do not face each other in the gallery.

As previously stated, they only infest sappy or moist wood. As soon as the wood reaches a certain stage of dryness, the adult beetles leave the wood and the immature beetles and larvæ die in the galleries. Therefore the greater part of the damage is done between the time the tree is felled, and before it is cut up in the sawmills, because the sawn timber dries so quickly under ordinary conditions that the beetles cannot continue egg-laying.

In some cases where freshly-sawn brush timber is closely stacked in a forest sawmill yard, the beetles may be attracted to it, and burrowing through the surface of the boards do a certain amount of damage during the first few days of its seasoning.

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In slowly-dying fallen trees the life cycle of the beetles may extend into several generations, and the beetles and larvæ will be found at work deep into the stem of the tree while it retains the least moisture.

The following species have been described from Australia and Tasmania, one of which I have had identified as ranging into the Solomon Islands.

Platypus australis, Chapius.

(Memoires Leige, Vol. xx, p. 240, 1866.)

This species was described by the French entomologist F. Chapius in his "Monograph of the Platypides," published in the above journal. The specimens came from the Bakewell collection and were collected in the Moreton Bay district, Queensland. A second species from the same locality he called *Platypus crematus.* Lea, in a paper in the Proceedings of the Linnean Society of New South Wales, 1904, says that both are common in the Tweed River forests, New South Wales, and that the latter is the female of *P. australis.*

I have found it the commonest species in the more southern forests of the Dorrigo Plateau, and have received specimens, through the curator of the Queensland Museum, collected near Cairns, North Queensland.

I have cut them out of the stems of fallen Sassafras trees (*Cinnamomum Oliveri*) and from several other unidentified tree trunks in the forest. I obtained a number of larvæ and beetles in some boards of Bolly Gum (*Litsœa reticulata*), freshly cut from a Sydney sawmill. At the Brooklana Timber Mill, Dorrigo, I had a number under observation, in some very wet weather in January, cutting through the surface of some freshly-barked Hoop pine logs (*Araucaria Cunninghami*), which were waiting to be cut up when the rain stopped.

This beetle measures a quarter of an inch, the head antennae, thorax, legs and under surface shining reddish brown. The wing covers also shining, but much darker, finely striated and contracted on the sides about two-thirds from the base, the narrowed tips, sharply truncated and thickly clothed with fine reddish hairs. The female is similar in colouration, but the body and wing covers more cylindrical, not contracted on the sides, but sharply rounded at the tips clothed with reddish hairs.

Platypus geminatus, Chapius.

(Memoires Leige, vol. xx, p. 259, 1866.)

The beetle was described by the same author from the collection of M. de Mniszech, the locality given being New Holland. I have not seen this species in any Australian collection, but have cut specimens out of timber logs from the Solomon Islands, which have been identified by Lieut-Col. F. Winn Sampson as this species.

A short thickset form, measuring a quarter of an inch. Of a uniform bright reddish brown colour, the face lightly clothed with short reddish hairs; the wing covers deeply and distinctly ribbed with parallel striæ, the outer margins lightly clothed with reddish hairs, and the turned down, rounded tips, each having a blunt spine in the centre and thickly covered with reddish hairs.

Platypus froggatti, Sampson.

This large species was forwarded by me to Lieut.-Col. F. Winn Sampson, who determined it was an undescribed beetle, sending me the above ms. name under which he is describing it.

It is the largest Australian species in our coastal forest, and confines its attention to the freshly-felled Hoop pine logs, attracted to them as soon as they are barked by the timber-cutters and left in the forest for transport to the mill. I have cut them out of such logs, and watched them entering logs in the saw-mill yards. They are most active in the damp, warm weather in December and January, and when the logs through adverse weather conditions cannot be put on the saw bench these beetles often penetrate several inches into the solid wood and do a great deal of damage to a log. In one case where a large strip of bark had not been removed from the log these beetles cut right through it, therefore leaving the bark on logs kept in the forest, as had been suggested as a means to protect them from shot-hole borers, would be no guarantee that the logs would be immune to the attacks of this beetle.

I had a number of specimens working in some sections of planks cut off an infested log. Most of the beetles emerged within a week; and the rest died as the wood seasoned. As their host tree the Hoop pine ranges well into Southern Queensland one would expect to find this beetle in such country, but I have seen no specimens in Queensland collections.

This beetle measures nearly one-third of an inch, and is of a uniform shining black tint with the antennæ, legs and under surface light reddish brown, head lightly clothed with reddish hairs, and a few scattered over the prothorax. The wing covers rounded, finely striated, with the apical portion irregularly punctured, the rounded extremities and sides thickly clothed with bright reddish hairs, forming regular parallel stripes on the tips. In the male the apices of the wing covers produced into a small spine, which is wanting in the female.

Platypus omnivorus, Lea.

(Proc. Linn. Soc. N.S. Wales, p. 104, 1904.)

(*Crossotarsus omnivorus* Lea, Sampson Arkiv För Zoologi, Band 17, No. 16, 1925.)

This beetle was originally described by Lea from Tasmania. He gave it the specific name *omnivorus* because he found it attacking so many different kinds of trees. He recorded it from an orchard infesting plum, apple, and apricot trees. This orchard, however, was adjacent to bush land where a number of Black Wattles (*Acacia decurrens*) and Silver Wattles (*A. dealbata*) had been recently stripped of their bark, and where there were also ringbarked gum trees all of which were attacked like the fruit trees. These beetles had evidently been attracted to the dying forest trees in the first place, their natural host trees, and from them invaded the nearby orchard. As under normal forest conditions these borers do not touch perfectly healthy growing trees it is more than probable that the orchard trees were in poor condition, or the egg-laying beetles were in excess of their forest host trees.

This beetle had not been recorded from the mainland until I forwarded some specimens to Lea for identification, which I had collected in freshly-sawn brush timber at a saw-mill at Mt. Irvine, Blue Mountains. Its habits and life history were described and figured in the *Agricultural Gazette of New South Wales,* 1921, in a paper entitled "The Shot-hole Borer, *Platypus omnivorus.*" An abridged account from this article, accompanied by the illustration, is given in my Forest Insects of Australia, 1923. Since then, while carrying out investigations regarding the life histories of timber-boring insects in the coastal forests of New South Wales, I have chopped these beetles out of various forest trees, where they were just cutting into the bark, or forming their larval cradles, in transverse rows in the sapwood, to receive the next generation. This species in the forest seems to prefer the Sassafras timber, and is found in dying fallen trees, trees that have been scorched by bush fires, or freshly cut logs. At Brooklana, Dorrigo, I also cut several specimens of this beetle out of galleries in the trunk of a dead Blue Gum (*Eucalyptus saligna*) in December.

Mjoberg collected this species at Mount Tambourine, Malamba, Blackall Ranges, and Cedar Creek, Queensland.

Platypus semigranosus, Sampson.

(*Crossotursus semigranosus,* Simp., Arkiv För Zoologi., Bd. 17, No. 16, 1925.)

This species was collected in the Cairns district, North Queensland, by the Swedish naturalist, Dr. Mjoberg, and described by Sampson in the above journal. In a letter to me when identifying a collection I had forwarded to him, Winn-Sampson stated that the type was a male, and that my collection contained both sexes.

My specimens were obtained in the Dorrigo Forest, Brooklana, New South Wales, the first series from the stem of a felled Crab Apple (*Schizomeria ovata*), others from the trunk of an undetermined forest tree, and a third series from the stem of a dying Blue Gum (*Eucalyptus saligna*) on the edge of the forest.

The male measures one-fifth of an inch, is of a uniform reddish-brown tint, the head darker than the thorax, the wing covers slightly striated, with the apical half black and covered with short, stout spines forming regular rows, the extremities sharply rounded, also roughened and thickly clothed with short light-brown hairs. The under surface of the abdomen black and clothed with reddish hairs. The female is slightly longer, not so abruptly rounded at the tips, the wing covers more finely striated on the sides and only the tips slightly rugose, but thickly clothed with short reddish-golden hairs.

Platypus jansoni, Chapius.

(Memoires Liege, vol. xx, p. 244, 1866.)

This species though not recorded from Australia, has been received from the Solomon Islands, cut out of an undetermined forest tree, and could easily come into the Commonwealth with timber logs. It has been recorded from New Guinea, Celebes, Mollucca Islands, and the Philippine Islands, and evidently has a wide range over the East.

A short, rather thick-set beetle about a quarter of an inch in length. General colour, dark shining reddish-brown. Front of head clothed with short reddish hairs. Wing covers deeply striated, rounded at the extremities and clothed with fine reddish hairs, a small blunt spine on either side, a few scattered hairs along the sides of the wing covers.

WOOD-EATING ANTS.

(*Podomyrma bimaculata*, Forel.)

THE most dominant group of insects spread all over the face of the earth are the members of the great family *Formicidæ*. This includes all true ants, which are often popularly called "black ants" to distinguish them from the termites, which are commonly called "white ants"; although the termites have no affinity in structure with the true ants, and resemble them only in their habit of living in similarly large communities.

Australia is very rich in *Formicidæ*, varying in size from the big "bull dog" ants (*Myrmecia*) to the microscopic little red ants (*Monomorium*). They are found all over the surface of our great island continent. The great coastal forests, the semi-arid scrubs, and grassy plains of the interior, are inhabited by species which have adapted themselves to their surroundings, and they can stand all degrees of temperature.

In Central Australia several species of the genus *Camponotus* have evolved the habit of feeding a certain number of worker ants in the community with "honey dew." This honey dew is a sweet secretion obtained by the *Camponotus* ants from homopterous larvae of *Psyllids* and *Aphids* living upon the sap of the forest trees and shrubs. These selected workers are fed to repletion on this fluid, until the whole of the abdomen is distended into a "honey pot." Thus they store up larval food supplies for the baby ants in drought times. These are generally known as "Honey Ants"; they are dug out of their nests in the ground, and eaten by the aborigines in Central Australia.

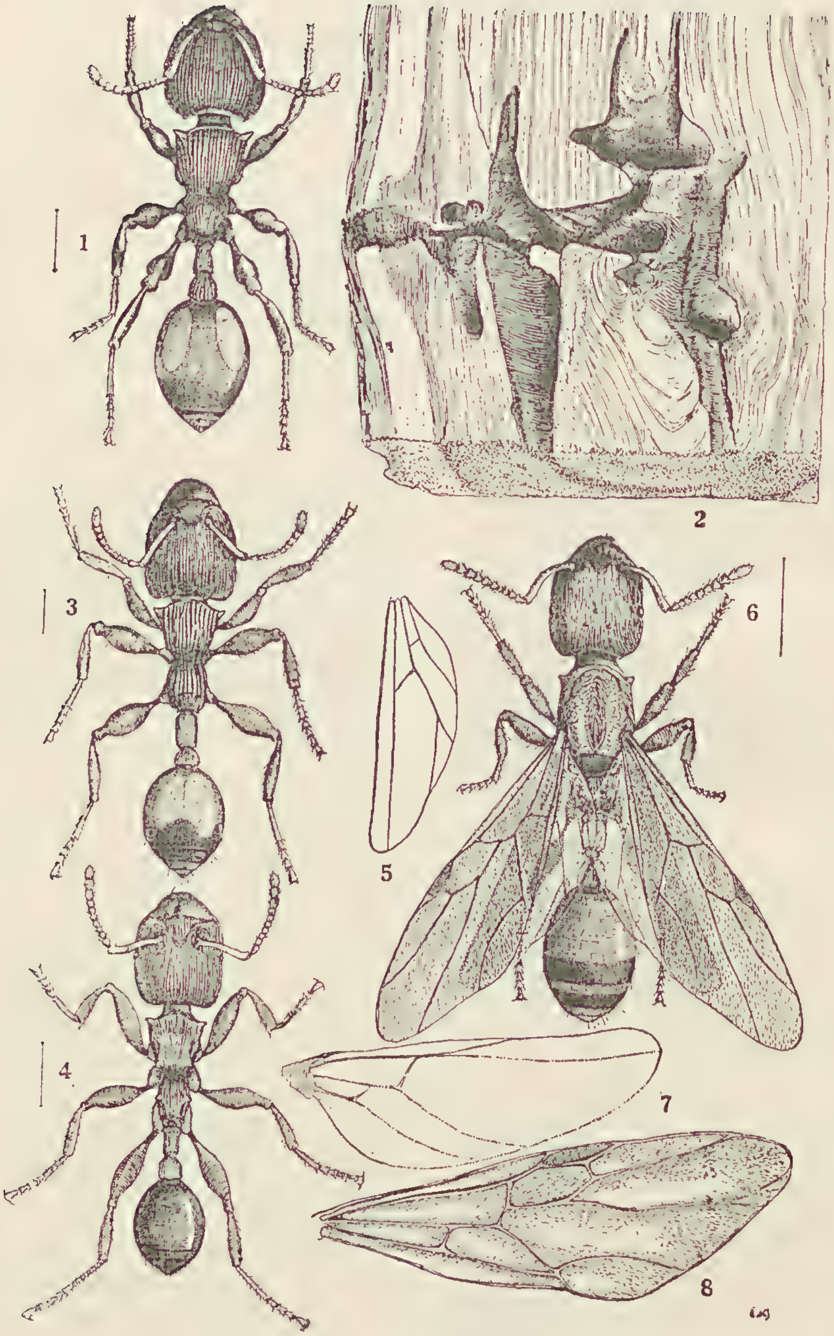
While most ants nest in the ground, either in regular mounds, or under the shelter of logs and stones, others are arboreal in their habits, living under bark in dead trees or old stumps. In the semi-tropical forests of the north, the Green-tree Ant (*Oecophylla smaragdina*) forms large arboreal nests among the foliage, webbing the leaves together with a glutenous silk, which the workers obtain by squeezing the bodies of their own larval ants. Other leaf-nesting ants belonging to the genus *Polyrachus* make more primitive nests, usually only folding down a large leaf and cementing the edges together into a purse or pocket, or at most connecting two or three leaves into a few chambers.

Ants may be broadly considered "forest" insects; for it is under the shelter of the forest that they swarm and multiply, either in the open forest country or in the more dense cedar brushes of the coast. The most prolific and widely distributed ant in Australia is the "Mount or Meat Ant" (*Iridomyrmex detectus*). They form their large mounds in lawns, parks, and open forest lands; the galleries beneath the raised mounds containing countless thousands of active workers which, in the forest, often form regular pathways through the grass, beaten down as they go to and from their nests.

Under ordinary forest conditions ants may be considered useful insects. They are forest scavengers, destroying many noxious insects; and incidentally they form a large portion of the food supply of many of the forest birds. When, however, they take up their quarters under or in houses, they become domesticated like the tiny, cosmopolitan "Red Egyptian Ant" (*Monomorium pharones*) and are a very serious pest to the housewife. Others, like the "Variegated Sugar Ant" (*Camponotus rufipes*), live in earthen banks, and have learnt to come into the houses at night to forage for food in the pantry.

The ants illustrated in this paper, however, are typical forest ants which dwell in cavities in living trees. They gnaw these cavities out of the trunk of the tree with their stout chisel-like jaws. They usually commence their opening in the surface of the

PLATE XXV.



Wood Ants of the Genus *Podomyrma.*

1. Worker wood ant, *Podomyrma bimaculata.*
2. Cross section of stem of a cypress pine showing nest of wood ants.
3. Worker ant, *Podomyrma striata.*
4. Worker ant, *Podomyrma gratiosa.*
5. Hind wing of *Podomyrma gratiosa*, male.
6. Female *Podomyrma gratiosa.*
7. Hind wing, female, *Podomyrma gratiosa.*
8. Fore wing, female, *Podomyrma gratiosa.*

trunk at a knot hole or a depression in the bark. Probably they often first remove dead or decaying tissue; and then enlarge the galleries and chambers into the surrounding solid wood.

The section of Cypress pine wood shown in the accompanying plate is, however, all solid wood, and the wood ants have apparently excavated these chambers out of the solid pine stem right through the bark.

The genus *Podomyrma* was created by Frederick Smith, of the British Museum, in a paper he contributed to the Proceedings of the Linnean Society of London in 1859. In this he described the collection of Hymenoptera obtained by the famous naturalist and explorer, Alfred Russel Wallace, in the Aru Islands. Four species were described, one of which, *Podomyrma striata,* is also found in Queensland. When defining the genus he said: "It is closely related to the genus *Myrmecena*; but with the exception of the number of joints in the palpi, they have very little resemblance to each other. They are the largest members of the sub-family *Myrmecinæ,* with the exception of the typical *Myrmecina.* All the species are distinguished by the remarkable thickened femora and sharply-margined thorax."

In my catalogue of the Formicidæ of Australia, published by the Department of Agriculture in 1905, twenty species are listed, three of which are figured on the plate illustrating the habits of the Wood-eating Ants.

The Spotted Wood Ant.

Podomyrma bimaculata, Forel.

This species was described by Forel in 1901 from specimens I sent to him from Kalgoorlie, West Australia, and from Wagga, New South Wales. It has a very wide range over the western Cypress pine country and is usually found upon the trunks of the Cypress pines (*Callatris* sp.) or in nests in cavities of the trunk, excavated by them out of the solid wood. In several instances I have found associated with their nests. the curious and living coccid (*Lecanium callitris*) recently described by me in the Proceedings of the Linnean Society of New South Wales, 1926. In the wood nest figured, two of these immature coccids were found right in the neck of the opening into the nest; so that every ant entering or leaving the nest walked over their bodies.

The worker ant measures slightly over the third of an inch. Its general colour is bright reddish-brown, with the thickened thighs and abdomen black, the latter having the dorsal surface ornamented with a large oval white spot on either side, from which it takes its appropriate specific name, *bimaculata.* The eyes are small and black, the jaws short and broad, the antennæ long and slender, the head and thorax closely striated, the broadly oval abdomen smooth and shining. They might be described as slow in their movements when crawling about on the tree trunk. They usually live in small communities.

The statement by timber-cutters and forest officers that Cypress pine is attacked by white ants is probably based on their finding cavities in sawn logs which have been excavated by these wood ants. Unless the real makers were discovered at work the damage might very naturally be attributed to the termites.

The Striated Wood Ant.

Podomyrma striata, Smith.

This was one of the species described in Wallace's collection from the Aru Island, but is now known from Cape York, Queensland, and it is common about Mackay, Queensland.

The female is reddish-brown, eyes ocelli, and jaws black, the femora shining dark reddish-brown, the tibiae and nodes of the abdomen yellow. Abdomen smooth, shining, the basal portion rich yellow, with the apical portion deep chocolate brown. Length about half an inch. The smaller worker similar in form and colouration, only the tints on the abdomen are not so distinctly defined; length one-third inch.

The Southern Wood Ant.

Podomyrma adelaidæ, Smith.

This was the first recorded species of these wood ants, for Smith described it in his catalogue of the Hymenoptera in the British Museum collections in 1858. He provisionally placed it in the genus *Myrmecina,* but considered it should be the type of a new genus. I collected it at Bendigo, Victoria; and it has an extended range over New South Wales, generally forming its nests in the stems or main branches of the smooth-barked gums, such as *Eucalyptus maculata,* spotted gum.

The Larger Wood Ant.

Podomyrma gratiosa, Smith.

This species was described by Smith in the same publication as the lastnamed ant. It has a very wide range over Australia, having been recorded from Cape York round to South Australia, and probably extends right through to Western Australia. It is somewhat similar in colouration to *P. striata,* but the colour of the abdomen is reddish-brown and dark chocolate brown in the female, and in the worker the whole of abdomen is dark chocolate brown to black. It is the largest and commonest wood ant in Australia, and usually found living in small communities in the centre of damaged stems of various species of smooth-barked Eucalyptus.

THE WHITE ANT OF THE HOOP PINE.

Parotermes (*Calotermes*) *Adamsoni,* Froggatt.

White ants, scientifically known as termites, are a remarkable group of insects. In old times they were placed by specialists in the same order as the locusts and the grasshoppers, or else among the ant lions and the lace-winged flies. Now, however, under modern classification, they are placed in the Order *Isoptera,* and are grouped near the orthopterous cockroaches and the earwigs.

Most writers on white ants, regard them as injurious insects. Under normal forest conditions, however, when undisturbed by the advent of man, they are scavengers in the virgin forest lands, and they aid Dame Nature in keeping the floors of the forest swept and garnished. They steadily gnaw up all dead waste wood, dead trees, stumps, and logs; and the wood fibre, after passing through their bodies, is returned to the surface of the soil, and is fertilising material for the further growth of the seedlings, the fresh baby trees, in the forest.

They are only injurious insects when, out of place, they come in contact with seasoned timber in buildings, and in New South Wales alone annually destroy with misdirected energy many thousands of pounds worth of useful material. When timber-getters, in felling trees, leave the stumps, the branches, and the heads of the trees littering the ground, white ants naturally increase in numbers with the increased food supplies.

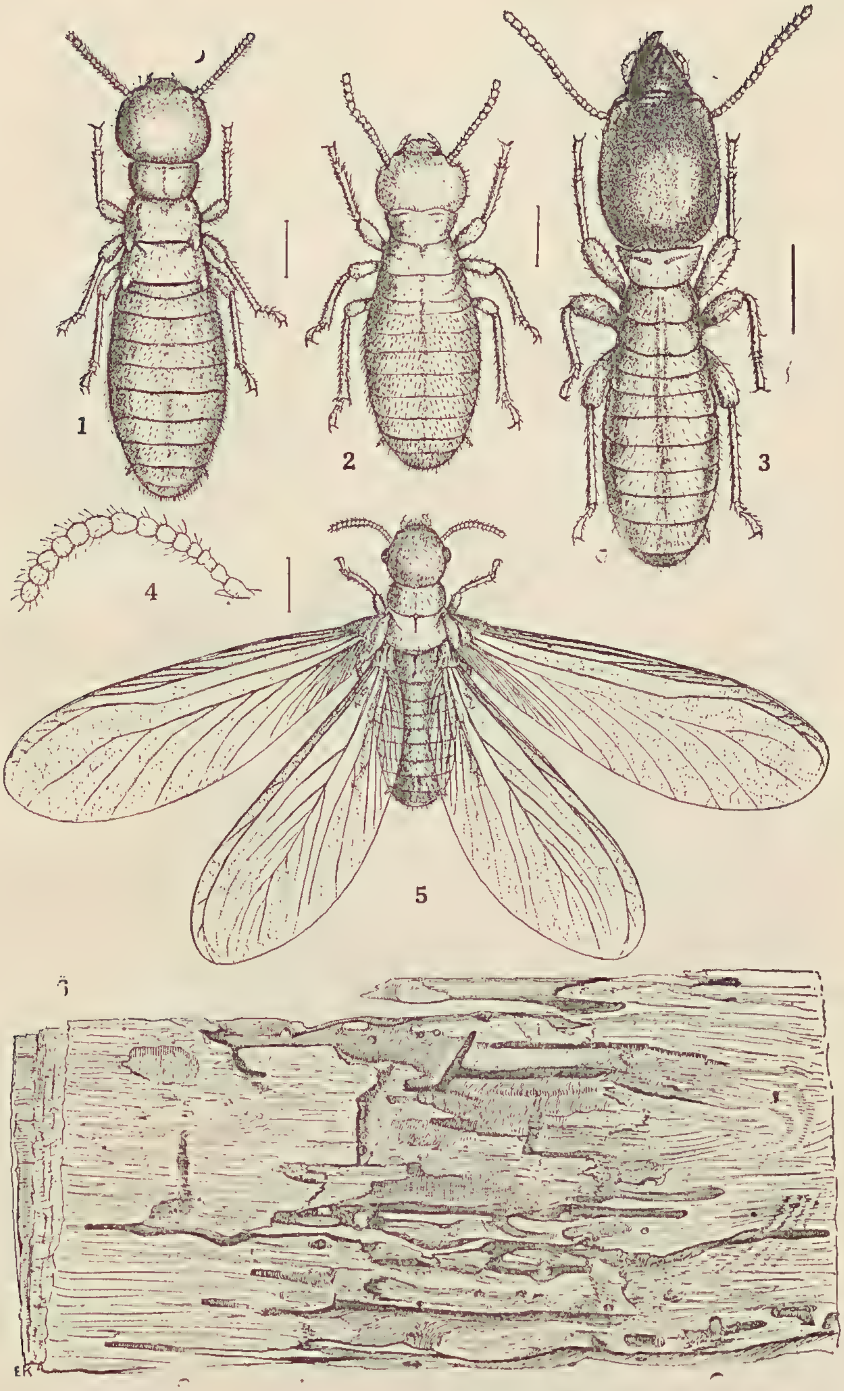
All over the coastal districts, and even in the dryest lands of the interior, wherever trees grow, and dead wood accumulates, white ants can hold their own. They retreat into their underground galleries in the midsummer, where, protected from the intense dry heat, they remain through protracted droughts until the rain storms come. It is very interesting to notice how, after the first heavy fall of rain, they swarm up into every bit of dead wood, cow dung, and logs lying on the surface, where previously one could not find a single specimen.

White ants' nests, known as *termitaria,* are usually formed over a stump or log. A nest consists of a stout sheathing of clay, enclosing a dome of chewed-up woody material; inside this dome are the network of galleries traversed by the workers and the soldiers, and also the special chamber of the wingless queen white ant. Her mission in life is to lay eggs for the continuation of the community. In close proximity to the queen chamber are the laminated galleries; the nursery, to which the eggs are removed by the workers, and in this area the tiny white larvæ hatch out, and, fed by the workers, remain during the earlier stages of their development.

While a number of species of white ants construct regular nests on this plan, others live in smaller communities, and simply eat out a cavity or series of galleries in a dead stump or branch.

The members of the sub-family *Caloterminæ* to which the species dealt with in this paper, belongs, are not nest builders, and though there is a queen hidden away in well established communities, I have never found a distinct chamber for her protection, and she is thus often very hard to find when a cavity is opened out. Unlike the more typical termites, these have very few soldiers in their nests in comparison with the workers; sometimes it is difficult to obtain a dozen in an active nest. The soldiers are distinguished by their large flattened yellow heads and their stout, thick-set, toothed mandibles. They are very retiring in their habits, and do not show any of the bravery of the smaller *Termes* and *Eutermes* when their nest is broken open. Instead of standing guard, while the workers repair the damage, like

PLATE XXVI



The White Ant of the Hoop Pine.

Parotermes (*Calotermes*) *Adamsoni*, Froggatt.

(1) Immature form of winged white ant, showing the rudimentary tips of the wings on the sides of the prothorax.

(2) Worker white ant (*Parotermes* (*Calotermes*) *Adamsoni*).

(3) Soldier white ant (*Parotermes* (*Calotermes*) *Adamsoni*).

(4) Antennæ of winged form.

(5) Fully developed queen or female white ant. Before egg-laying she looses her wings, and her body becomes swollen out with egg tubes.

(6) Section of a hoop pine stump, showing how the galleries are cut out of the solid wood.

the latter, they retreat into the galleries as soon as they are exposed, leaving the helpless workers to shift for themselves.

Many years ago, when hardly anything was known either about the different species or the habits of Australian termites, I studied the white ant question, the results were published in my "Monograph of Australian Termitidæ" (Proceedings of the Linnean Society of New South Wales, 1896).

Before starting this investigation I sent out a circular to correspondents all over Australia, explaining how to find and collect specimens of the different castes and sexes direct from the nest, and asked for their assistance.

Among them was Mr. G. McD. Adamson, of Uralla, who was a keen collector, and sent me many interesting specimens, among them this undescribed species, which I dedicated to him, under the name of *Calotermes Adamsoni*, in my Monograph.

During my forest investigations in the pine forests of the Dorrigo plateau I have, when cutting insects out of the dead pine stumps and logs, found that this species is the particular one which attacks the timber. The manner in which this is done is shown in the admirable illustration, drawn by Miss King, accompanying this paper.

THE BUBBLE LEAF-GALL THRIPS.

(*Kladothrips* sp.).

A NUMBER of Australian insects found in the dry inland areas of the continent have developed protective habits These protective habits, which have enabled them during their life cycle to withstand the intense heat and dry conditions of the interior, have been assisted by their hardy drought-resisting food plants (chiefly open forest scrub trees).

Upon the surface of the foliage, under such conditions, the eggs and delicate larvæ would, during the process of development, have a hard fight for their existence. Such adverse surroundings are evidently responsible for the habit, which a number of our insects, belonging to different orders, have evolved in protecting themselves under the shelter of galls upon the foliage or branchlets of their food plants. Here both adult insects and larvæ can live through the midsummer.

Most of the plant galls of Europe and America are produced like the oak galls—by the direct action of the female insect puncturing the leaf or twig, and depositing her egg in the wound. The intrusive egg starts the gall. This resultant mass of aborted tissue is the incubator of the egg; and is also the cradle of the larva, and where its complete development takes place. The adults insect cuts its way out of the gall and escapes after the final pupal moult.

Although most of our typical dipterous and hymenopterus galls are produced in manner as the European galls, by the intrusion of the egg. In our gall-making coccids, it is the active microscopic larvæ, with no apparent sexual difference, which produce and mould the dissimilar structures peculiar to each sex of the same species—one usually a tubular gall containing a delicate two-winged male, and the other a solid wooden box with a small opening at the apex, through which the larvæ can escape from the entombed mother, an aborted mealy bug, which dries up into a brown shell after egg-laying.

Some of our Psyllids, and the Aphids of the Old World, are larval gall formers. The remarkable point in the life history of the gall-making thrips, and particularly in those forming "bubble-leaf galls," is that it is the action of the adult female which creates the gall. She often absorbs the whole of the slender wattle leaf and leaves only the leaf stalk and tip standing out on either side of the gall. In this case the female thrips never emerges from the chamber, but lays eggs all her entombed life; her dead body is found in the bottom of the dried gall with the cast pupal skins of her escaped fully-developed numerous family.

The Australian insect fauna is very rich in *Thysanoptera* (thrips). They confine their attention to indigenous plants, both free living and gall-making species, and the largest known thrips (*Idolothrips spectrum*) is peculiar to Australia. It has the curious habit of developing among the dead gum leaves of fallen saplings resting on the ground, where there appears to be little nourishment for the tiny larvæ. In other parts of the world thrips live upon the surface of leaves or flower buds, and they are popularly known to gardeners as "Black Fly." There are a number of these domestic or garden thrips, which have been accidentally carried

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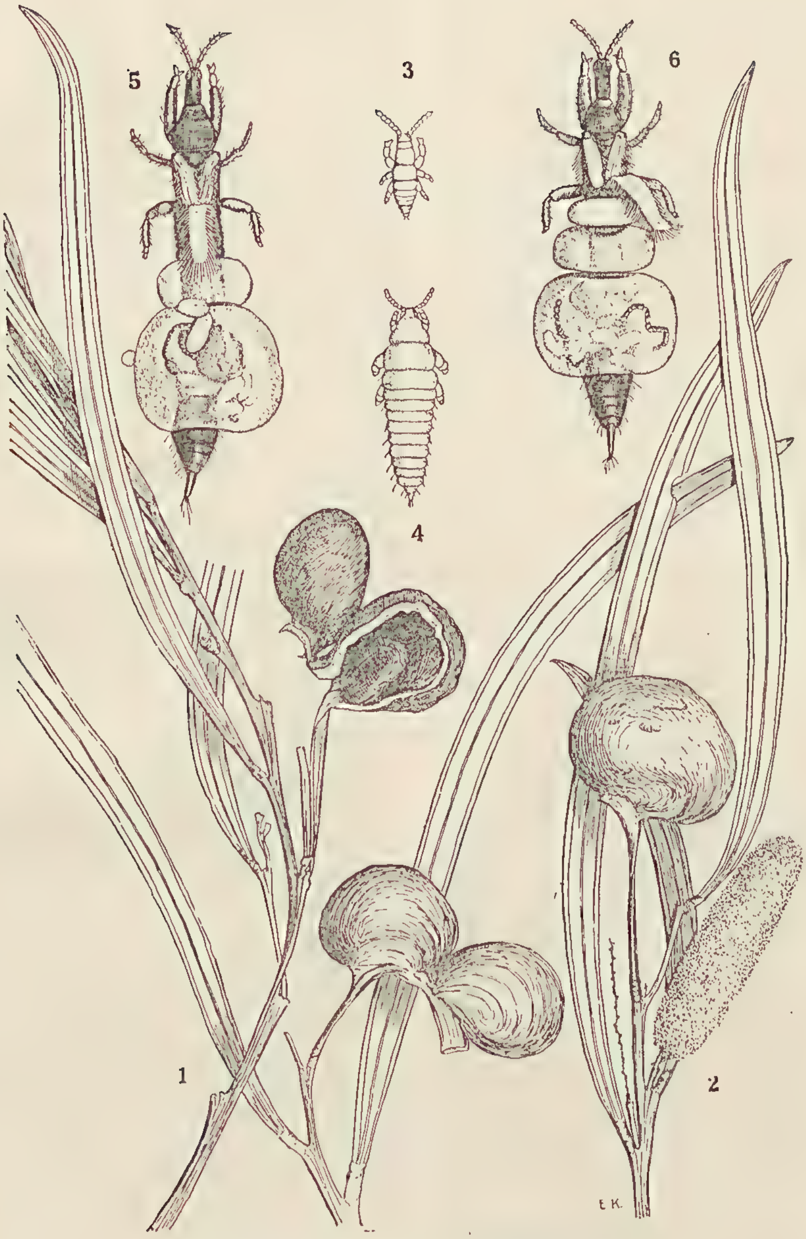

The Bubble Leaf-gall (*Kladothrips*, sp.).

1. Showing double galls on *Acacia doratoxylon* and cross section.
2. Showing single gall and bloom of *Acacia doratoxyln.*
3. First larval form of Bubble gall thrips *Kladothrips* sp.
4 Second stage larva, of Bubble gall thrips *Kladothrips* sp.
5. Adult female *Kladothrips* sp. showing first development of the abdominal segment.
6. More advanced development of the abdominal segments facing the folded wings upwards.

all over the world with their introduced food plants, and are now cosmopolitan in their range. From their small size they are not very noticeable upon plants until the blanching of the foliage indicates their presence. Thus, reproduction is so rapid that, on a dry season, they are a very serious garden and orchard pest.

Among a number of our indigenous gall-making thrips none are more remarkable than those previously noticed as "Bubble Galls." I have collected several species on the foliage of our western wattles, and the bushmen's Mulga Apple is, I believe, the gall of a thrips. Tepper collected his species in South Australia on the Mulga (*Acacia aneura*). I have had other galls sent round from North-west Australia, which had been some weeks on the journey, and which contained living larvæ on arrival in Sydney. The growth of a Bubble Gall is commenced by the adult winged black female, *Phlocothrips*, puncturing the under surface of the midrib of the slender wattle leaf. It causes a little bag or blister like swelling to appear on the upper surface. This gradually swells out, as it transforms the whole of the leaf into an irregularly-rounded bag or bubble. The walls of this structure are not much thicker than the leaf, but the texture is more tough and leathery. During the process the opening scar on the under surface consolidates and the mother thrips is hermetically sealed up. The outer surface of the gall is smooth and green, the interior is reddish-brown and slightly rugose. The larger specimens may be an inch in diameter.

In August, 1926, Mr. George Withers, Forest Officer at Gilgandra, found a wattle tree, locally known as "Motherumbung" (scientifically *Acacia doratoxylon*) covered with these curious leaf galls. Sometime they were in pairs on the same leaf, but usually single. Interested in the matter, he forwarded me a box of freshly gathered wattle galls for investigation.

The galls arrived in perfect condition, and upon opening some, I found each contained a solitary female at the base of her gall. The inner surface all round her was plastered with semi-transparent eggs and tiny emerging larvæ. The mother thrips was still continuing the work of reproduction.

On extracting several of these gravid females from their resting place and placing them on a glass slip, I found that these solitary mothers had undergone a remarkable body development since she had first become enclosed in the gall. All her structure was normal except the abdomen. The first three segments of the abdomen were swollen out into transparent globes, enclosed in the membrane, between the dorsal plates, which once had been in contact and were now separated by the excessive enlargement of the abdominal segments. This enlargement was so great, that the slender feathered wings, which should have been folded down her back, were now turned upward at the base of the first segment. When live specimens were placed under the microscope all the movements of the internal organs of the abdomen, with the outline of the egg masses, could be observed within each transparent globe. This swelling of the abdominal segments of the mother or queen thrips was analogous to that of the Queen Termite in a white ant's nest.

In these thrip galls the females and immature larvæ died as the gall tissue dried and hardened, and the specimens were collected and mounted for the cabinet.

A second consignment of fresh galls was received from Mr. Withers on 3rd December, 1926, with the following notes:—"I found on visiting the wattle that a large number of the gall-infested leaves had fallen and the galls on them were empty; other green galls upon the tree were also empty, others were chock full of insects."

On examination, I found that most of the empty galls had been punctured and others tenanted by a moth caterpillar. The others were packed with well-grown semi-transparent larvæ of two sizes, and the antennæ of a number were tipped with black. Opening one of these galls in a glass tube, I chloroformed the contents and counted out the bodies. The count made just over 1,000 larvæ. The adult thrips will probably be found just about the New Year.

This remarkable species, of which the life history has been so well illustrated by Miss King, according to Mr. Dudley Moulton, of California (to whom I submitted the specimens), is an undescribed gall thrips. He has determined it as belonging to the genus *Kladothrips*, the type of which is my species, *Kladothrips rugosus*, also forming galls on Acacias. Another allied gall thrips is *Phlocothrips tepperi*, described by Uzel from galls collected by the late I. G. O. Tepper, of the Adelaide Museum, who found them on the "Mulga" (*Acacia aneura*) at Broken Hill.

THE RED CEDAR TIP MOTH.

(*Hypsipyla robusta*, Moore.)

With some account of its Habits in Australia.

THE red cedar tip moth, which checks the upward growth of the young red cedars growing in our native scrubs, is not confined to Australia, but has a wide range over the East. It is the most serious pest which attacks this valuable tree, and is the chief cause of red cedar not being set out in plantations by the Forestry Commission.

In Australia it ranges from Northern Queensland to Gosford, New South Wales, which is about the most southern cedar brush in this State. It has an extended range over India, Ceylon, and the Malay Archipelago. The first entomological record of this moth was published in the first volume of *The Indian Forester* in 1876. In this paper the writer described an unknown moth attacking the young shoots of the toon tree, both in plantations and in forest lands. He stated that it preferred the young seedlings, about 3 feet in height, which were growing in the cleared spaces on the edge of the forest, rather than where they had grown up under the shelter of the larger forest trees.

It was not until 1886 that the Indian entomologist, Moore, obtained specimens sent to him from Ceylon and gave a scientific description of the moth, naming it *Hypsipyla robusta*.

In 1919, Dr. Beeson, Forest Entomologist to the Imperial Government, stationed at Dehra Dun, published an account of the life history of this moth in a paper entitled "The Life History of the Toon Shoot and Fruit Borer (*Hypsipyla robusta*) with suggestions for its control (*Indian Forest Records*, vol. vii, 1919). This paper was also republished in the first volume of the *Australian Journal of Forestry*. In "The Report of the Proceedings of the Third Entomological Meeting at Pusa, India," (vol. 2, p. 700, 1919) Dr. Beeson contributed a paper on the "Shoot and Fruit Borer of the Toon." In this paper further information is given about this pest, and suggestions regarding its control made to the Forestry officer.

In these articles the writer states that field investigations in India prove that there are five generations of this moth annually. The life cycle of the first brood, commencing in March, takes from twenty-four to twenty-nine days; the moths lay their eggs upon the flowers, upon which the caterpillars feed until the first week in April. The second brood, or April generation, emerge when the fruits are nearly full-grown. They feast upon them, making a circular hole in the side, and eat out the seeds, leaving a hollow, punctured shell; the life history of this brood is completed in from three to four weeks. The caterpillars produced from the eggs of the second generation of moths confine their attention to the tips of the young shoots, which are put out during the heat of summer; but their life cycle occupies from nine to eleven weeks. The fourth brood of caterpillars feeds indiscriminately upon both young and old cedars, and takes about the same period to go through their transformation from egg to moth. The fifth generation of caterpillars hibernate on the eaten-out shoots for from fourteen to sixteen weeks; the whole of the life cycle taking from twenty-one to twenty-four weeks.

When writing my article on the cedar tip moth in my "Forest Insects of Australia," published in 1923, I had not had many opportunities for studying this moth in the cedar brushes under natural conditions in the forests of New South Wales or the actual conditions under which the red cedar grows in the forest. During the last three years, while closely associated with the officers of the Forestry Commission, I have travelled through many miles of the brush forests; and from the northern rivers to Gosford and Ourimbah I have collected specimens and studied the range and habits of the "red cedar tip moth," and its development under forest conditions.

In the first week of July, before the red cedar had opened its leaf buds, I paid a visit to the rich alluvial valley near Narara, known as "Hogan's Brush," where many exotic trees were planted by the first Forestry Commission about thirty-three years ago, among them the cedars now growing in this area. Going over the trunks of the larger trees I found, under a scale of dead bark, five white silken cocoons containing live pupæ. They subsequently died, so no moths were obtained from these specimens.

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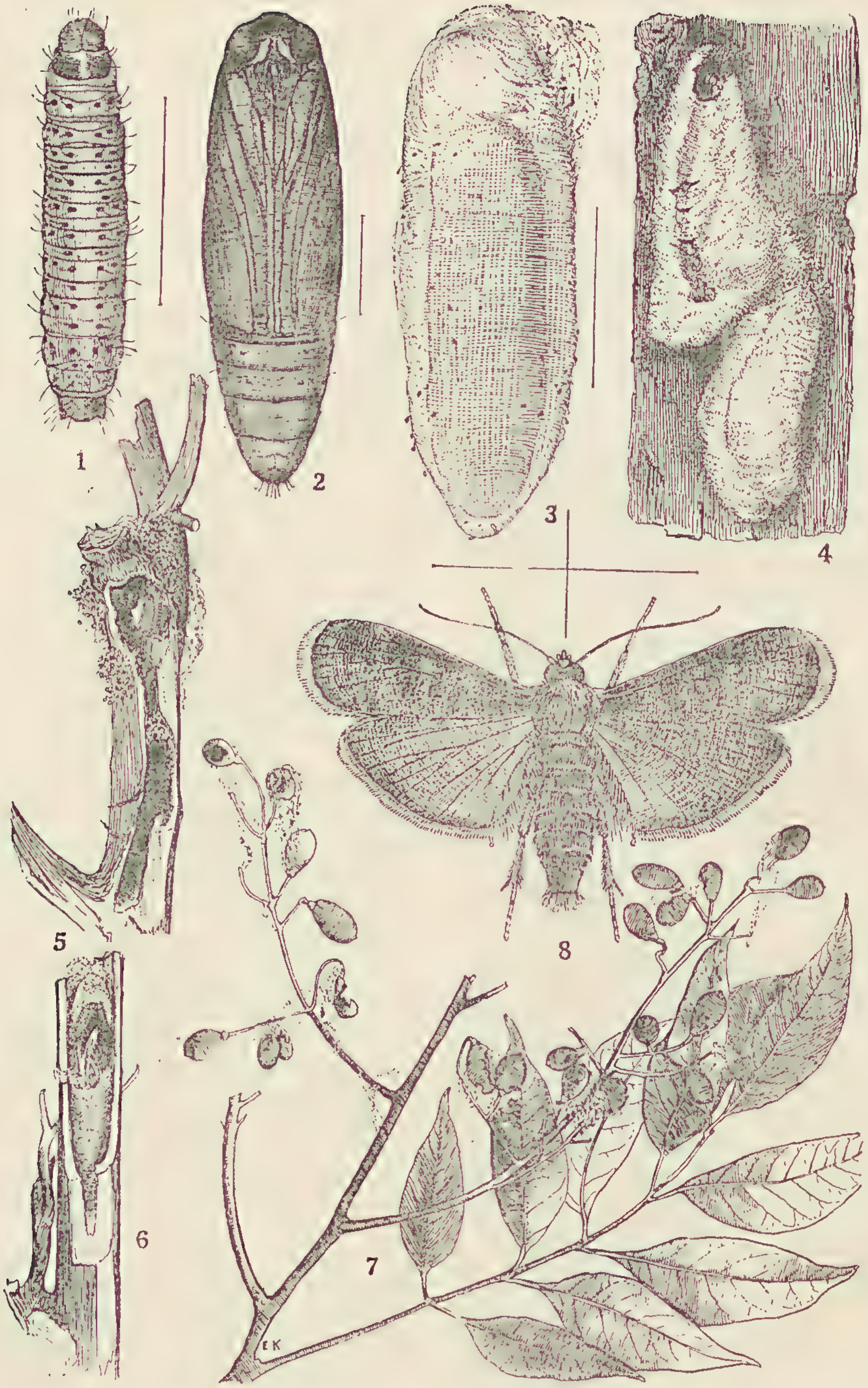
PLATE XXVIII.



The Red Cedar Tip Moth.

(*Hypsipyla robusta*, Moore.)

· Full fed larva of red cedar tip moth.
2. Pupa removed from silken cocoon.
3. Cocoon containing pupa spun among foliage.
4. Cocoon spun under shelter of dead bark on tree trunk.
5. Tip of cedar shoot, showing damage caused by larva.
6. Similar stem from young tree, showing pupa in cavity.
7. Spray of fruit and foliage of red cedar, showing damage to seeds caused by caterpillars.
8. The red cedar tip moth (*Hypsipyla robusta*) Female.

Early in the following month (August) I examined a number of fair-sized cedar trees, which had been planted years ago along the roadside in the Ourimbah district, and others in an adjacent scrub. At this date the leaf buds had not expanded, and there was no evidence of pupæ upon the trunks. The bare branchlets were thickly encrusted with the mature female tests of the Indian wax scale, *Ceroplastes ceriferus*, but they did not seem to affect the development of the trees.

Early in September the local Forester, Mr. Freeman, and I visited the Forest Reserve on the Styx River, which, on account of its cedar, had been fenced in some years ago. Here the trees have had a chance to grow without being damaged by horses or cattle. At this date the young trees were in full foliage, and the old trees were bursting out into delicate, pinkish foliage. We examined a number of young trees, and found that those growing in the open, away from the shelter of the scrub, were more or less infested at the terminal shoots; the caterpillars feeding on these tips swere small, slender, and dull reddish-brown, quite unlike the obese, rich, blue-coloured matured caterpillars found later in the season just before they pupate. We could find no cocoons of live pupæ under the bark of the tree trunks, and the few old pupal skins among the cracks were of last year's origin.

The next district visited was the Bulga Plateau, north of Wingham, towards the end of September. Very little young cedar was found in this area. At the bottom of a deep gorge on the Ellenborough River I found a large cedar; it had been felled some few months previously, but in such an inaccessible place that the cedar-cutters were unable to get it to the top of the range. I found it was infested by a pin-hole borer, which were boring well into the log, right through the sapwood. A number were cut out, and on examination proved to be *Platypus omnivorous*, one of the Scolytid beetles, which infest the dying wood of a number of different forest trees. This is the first record of these beetles attacking red cedar.

Towards the end of October I visited some of the forest areas of the Kyogle district with the local Forester, Mr. Moody, and rode over a considerable area about Iron Pot Creek; in several places we found patches of well grown trees, and young seedlings and suckers growing along the flats on the creek. Here we found the larvæ of the cedar tip moth busy upon the terminal shoots of the trees, varying in size from the tiny, slender, little, reddish-brown grub, just burrowing through the surface, to the larger, brightly coloured blue grub, spotted with characteristic black dots, filling the hollowed-out tip of the shoot. In an adjacent scrub we examined the trunks of a number of large cedar trees without finding any pupæ. It was probable that they were in flower, but we could not see their tops in the thick forest, if so; and our moths have the same habits as in India. The grubs we found on the young trees in the open may have developed from the moths where larvæ had fed upon the flowers.

As in several other areas visited, we found that horses and cattle were doing a great deal of damage to the young trees in the brushes, and that the greater number of the young cedars had been eaten down by stock.

In the middle of November I arranged with Mr. Love, District Forester at Kempsey, to visit the Grafton district, and to go through the cedar brushes between there and Macksville. Our first point of investigation was at Kangaroo Creek State Forest, where we found a fine growth of young cedars and some well-grown trees in the brush. Here the same conditions prevailed as at Iron Pot Creek; numbers of cattle were feeding on the brush and most of the young seedlings had been torn down or their tops bitten off. Where we were fortunate enough to find undamaged trees we found a few caterpillars in all stages of development at work on the tips.

At Cloud's Creek State Forest we found a few undamaged young trees. There were a number of larger trees scattered through the forest, some of which had been badly scorched by a bush fire a year or two previously; on cutting into this dead wood, I found that the sapwood was badly infested with powder-post beetles (*Lyctus brunneus*), though there was no outward evidence of their presence on the outer surface of the dead wood. Several adult beetles were cut out, and larvæ are still at work on the wood brought down to the Forestry insectarium. This is the first occasion on which I have found *Lyctus brunneus* in dead trees *in the forest.*

From there I proceeded to Bellingen; and I spent the first morning at an avenue of large cedars on the road to Dorrigo, planted along the edge of a paddock many years ago. The trunks of these trees were very rough, and I scaled the bits of dead bark off about twenty trees, finding a large number of silken white pupæ cases under cover of the dead surface bark. Though clean and fresh looking, none of them contained pupæ; about half of them contained the empty pupal skin from which the moth had recently emerged, and the others contained dead, dried-up larvæ, which had become infested with fungus spores before they had spun their cocoons, and never reached the pupal state. Under the conditions in which these larvæ had developed fully 50 per cent. had been destroyed by fungus. This is an important factor in checking the increase of the cedar tip moth.

The following day, returning from a visit further up the road with Mr. Dare, the local Forester, we obtained some fruiting sprays from one of these large cedars, and discovered that the fruits were being eaten out by the cedar moth caterpillars, which were nearly full grown.

On my return to Sydney, both Mr. Moody and Mr. Dare sent me boxes of cedar foliage and fruit heavily infested with caterpillars. Nearly every fruit was punctured, and the whole of the seeds were eaten out, leaving only the hollow, punctured shell. Only one larva pupated in an empty fruit; all the others either spun their elongate loose silken cocoons upon the foliage or on the bottom of the box in which they were kept under observation.

I found that a number of caterpillars could not be kept in the same box, because the most robust of them damaged and even devoured part of their weaker or less matured brothers.

I kept a number of pupæ under observation from the 17th December, the majority of which emerged on New Year's Day. The moths on emergence are very active, and in confinement damage their wings very quickly, and require to be killed and mounted as soon as their wings are dry, otherwise it is very difficult to obtain good specimens for the cabinet. The female is much larger than the male, though the males are most common. The abdomen of the female is much distended; one I dissected contained over 300 eggs.

Field Work.

The lines of investigation opened out in these notes show that there is room for much valuable information to be collected by a competent entomologist who is prepared to spend part of his time in the forests, and work in conjunction with the field officers of the Forestry Commission. It would appear from these preliminary investigations that the life cycle of the cedar tip moth in Australia will be similar in its annual generations to that of the Indian moth, allowing for the variations of climate and different forest conditions in the two countries.

Natural Conditions under which Red Cedar grows in North-eastern Australia.

The larger cedar trees are scattered all through the thick, semi-tropical scrubs, or "rain forests" as modern writers have classified them. When the pioneer cedar-getters blazed their tracks through the virgin forests on our northern rivers they found good cedar everywhere. Now they seem to follow the sloping lands on the sides of the creeks, and the few old warriors are at the bottom of almost inaccessible gorges.

There are not many seedlings noticeable in the thick scrub; the small trees and seedlings spring up along the flats and open ridges between the creeks and the margin of the forest with nettle trees and other shrubs which love the sunlight.

The fact that there are well grown cedars scattered here and there all through these brushes, which, in old times, were in consequence known as "cedar brushes," and from whence forty years ago enormous quantities of marketable timber was cut out by the cedar-getters all over the northern rivers, shows any reserves in such localities are the places to form plantations.

All these trees grew and developed, in spite of the cedar tip moth destroying such a large percentage of the seeds, and aborting the branches of the seedlings and young trees.

It appears to me that cedar is one of the most hardy and persistent trees in our forests. When broken down or burnt off it sends up a fresh growth. When the bark is injured or torn off, it sets to work, and fresh bark tissue forms and folds over the damaged area. There are a number of fine trees, if few in number, of those planted about thirty-three years ago in the valley near Gosford known as Hogan's Brush. Here, in spite of timber getters, fires, and depastured stock having had an uncontrolled hand, they have held their own.

It is a well-known fact all over the world that domesticated animals are the greatest drawback to the development of forests

The forests in the uplands of the Island of Cyprus during the Turkish occupation were devastated by the thousands of free-range goats from the villages, and it has been a constant fight since the British entered between the forest officers and the village communities to keep the goats within bounds.

Red cedar seedlings are very easily raised in pots, and I am informed that in Sydney there is no difficulty in getting them to shoot up into good saplings. Where cedar grew in old times it will grow again, if the same natural surroundings are restored. Though, as previously noted, a scattered tree in the forest, one authority says, that ten trees to the acre was a fair average, it should be quite easy under regeneration to grow them in regular groves in such forest areas.

In India a great deal of attention has been given to the cultivation of cedar, or " toon," as it is known in that country, and all the pests that attack it have been recorded by their entomologists.

In the Report of the Proceedings of the Third Entomological Meeting at Pusa, 1919, there is a paper by Dr. Beeson entitled " Some Problems in Forest Control," in which the writer says: " The weak link in the seasonal history of the insect occurs in the first two broods. In the absence of flowers or fruit of toon, mahogany, and other *Meliaceous* trees, these generations are very seriously checked. Shoots are not produced during this period by the host trees, except in insufficient quantity, and the incidence of the pest suffers a considerable reduction, which may amount to a complete hiatus. We have, therefore, a simple protective remedy. In order to establish a toon or mahogany plantation, it is sufficient to remove all flower-bearing host trees in the neighbourhood. If it necessary for silvicultural or other reasons to retain these trees, another measure must be adopted. A protective barrage must be established round the site of the plantation or regeneration area by sack banding the flowering trees, and destroying 'the toon moth' larvæ in the forest, just as codling moth larvæ are destroyed in fruit orchards.

THE FOREST HOOP-PINE BORER.

Hylastes, sp.

See Plate xxix (p. 94).

This little, thick set, black beetle is only found in the pine forests of the Dorrigo Plateau in stumps and logs of hoop-pine, which have been left in the shade and damp conditions of the forest, where the wood dries very slowly. I have never found them on the outside of logs or on the wing, so that, like many other of the small beetle borers, they probably move about in the twilight.

They are frequently very numerous in the wood of such moist logs, and will start from the surface and continue their tunnels right into the centre of the log working in the sappy wood until it dries out.

It is of a uniform black colour, with the antennæ and tarsi reddish brown; the mouth part clothed with reddish brown hairs, with scattered white hairs along the sides of the body. The wing covers finely ribbed, with parallel striae, consisting of fine circular punctures which, on the apical portion, are lined with short, course, reddish brown hairs, very easily rubbed off. It measures about one-eighth of an inch.

Specimens of these beetles were sent to Lieut.-Col. F. Winn Sampson for identification, who considers they are closely allied to *Hylastes perigrinus* described from New Zealand, and is an undescribed species of that genus.

THE RED BEECH ANOBIUM.

Hadrobregmus australensis, Pic.

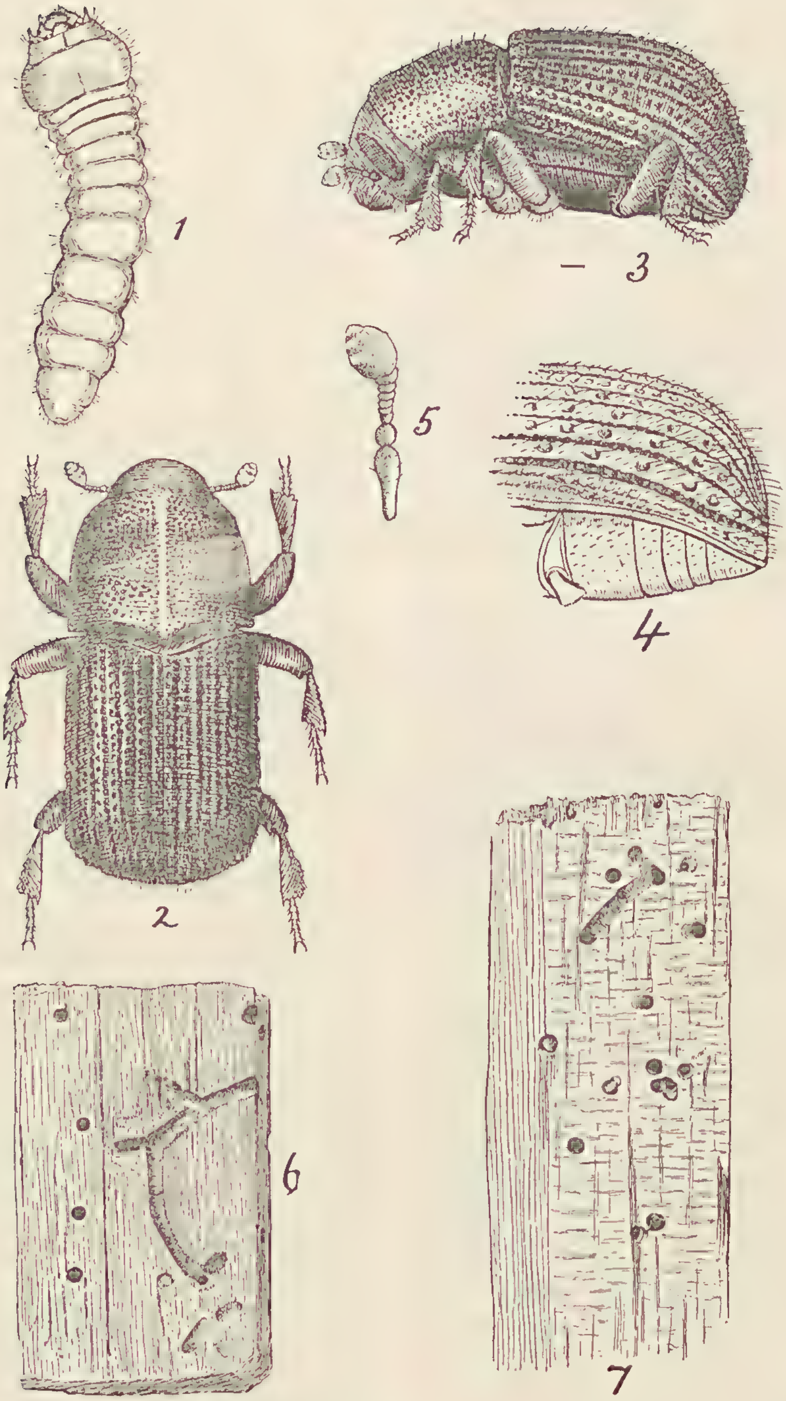
See Plate xxx (p. 95).

This beetle was described from Australia by the French Naturalist M. Pic in 1901. The genus contains sixteen species ranging from Europe to North and South America.

I obtained several specimens from burrows in a floor at Mosman Bay, composed of Red Beech, in a cottage which had been built some years. They had emerged through circular holes in the stained wood. On removing the damaged board it was found to be perforated with irregular broad galleries packed with wood dust running parallel with the grain of the wood. The wood was lightly infested, as there were only half a dozen flight holes, and there were no signs of any larvæ remaining in the damaged board.

I have received several specimens from Mr. C. French, taken from a similar floor in a house at Toorak, Victoria. In a collection of wood borers lent me by the Curator of the National Museum, Melbourne, there were several specimens of this

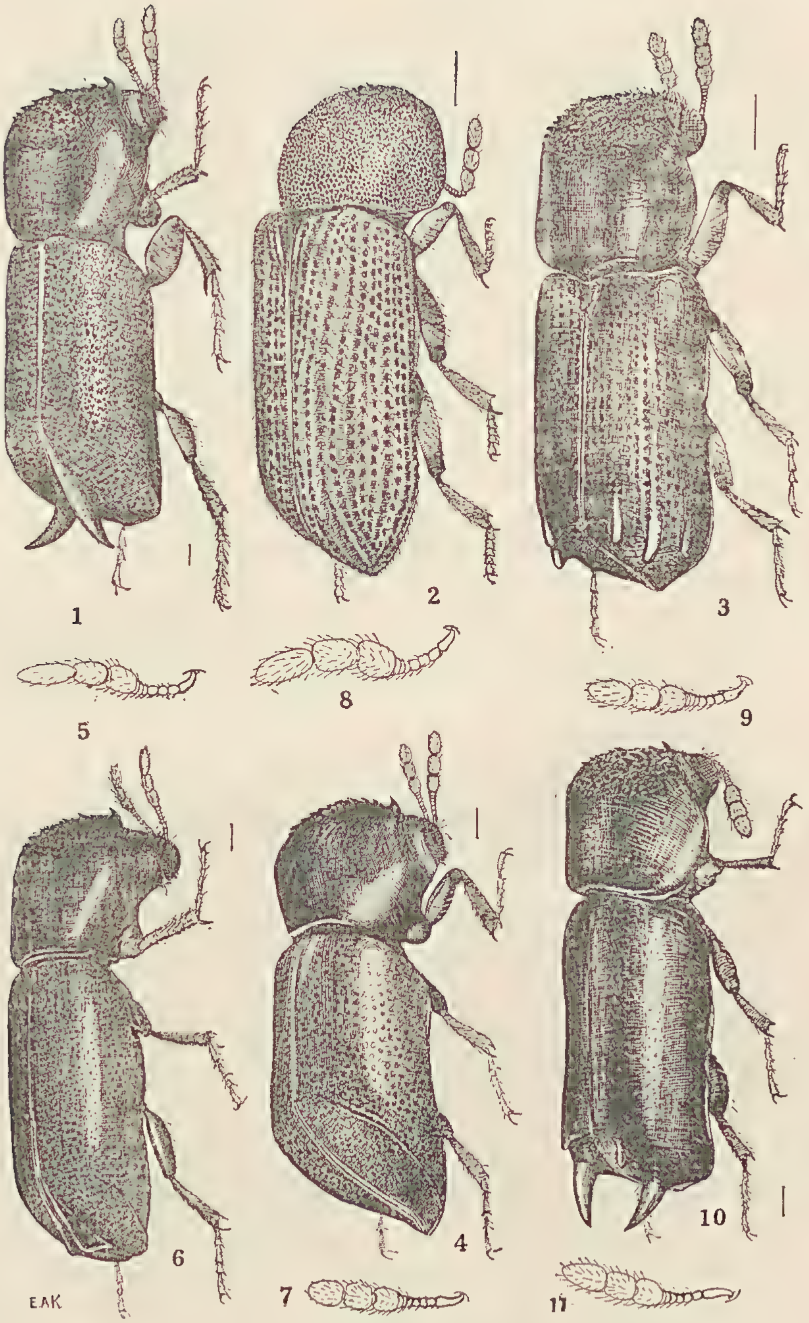
PLATE XXIX.



Dead Hoop Pine Borer (*Hylastes*, sp.).

1. Larva of Hoop Pine Borer.
2. Dorsal view of Beetle.
3. Side view of Beetle.
4. Enlarged view of apical portion of body.
5. Antennæ of beetle.
6. Showing bores made by beetle.
7. Another section of timber.

PLATE XXX.



Timber Borers.

1. *Xylobosca bispinosa*, Macl. (male)
2. *Hadrobregmus australensis*, Pic.
3. *Xylothrips religiosus*, Boisd.
4. *Xylosocus gibbicollis*, Macl.
5. *Xylobosca bispinosa* antennæ.
6. *Xylobosca bispinosa* (female).
7. *Xylosocus gibbicollis* antennæ.
8. *Hadrobregmus australensis* antennæ.
9. *Xylothrips religiosus* antennæ.
10. *Xylotillus lindi*, Blk.
11. *Xylotillus lindi* antennæ.

beetle from Tasmania and other localities in Victoria. In the early part of March, I cut a live specimen out of a dead Red Beech log in the Dorrigo forest, so that this beetle evidently has a wide range in our coastal forests.

The beetle is closely related in form to the typical anobium, but is twice the size of *Anobium punctatum*. The general colour is black, the dorsal surface of the prothax rugose, covered with small, rounded knobs, with the sides finely punctured. The wing covers deeply marked with close, parallel rows of almost square punctures; the whole of the dorsal surface clothed with scattered light brown hairs.

NATIONAL MUSEUM OF VICTORIA

Catalogue of the Described Species of the Family *Bostrychidae* found in Australia.

This family is well represented in Australia; some are local, others have a wide range. They are popularly known as "Shot-hole Borers," or "Auger beetles." In 1896 Paul Lesne published the first part of his "Revision des Coleopteres de la Famille des Bostrychides; it appeared in the Annals de la Societe Entomologique de France. The fifth part concluded in 1901. In these memoirs he classified and redescribed all the known species, most of which were placed in new genera; he added a number of new species, and illustrated his bulletin with outline drawings in the text, showing the specific and generic characters. Previously other species had been described by Macleay, Blackburn, Lea, and others, but, with most of these, the descriptions have thrown little light on the habits, range, and exact food trees of the beetles.

I have collected a large number during the last three years direct from infested trees and logs in the forests, and have obtained large series, in many cases consisting of both sexes of the species.

I have also seen all the Australian Museum collection (with the exception of the Adelaide Museum), and had others from collectors from most parts of the continent. So that I think a descriptive catalogue should be a useful appendix to this Bulletin.

Family BOSTRYCHIDÆ.

Genus DINODERUS, Stephens.

The members of this genus are tiny little borers which infest rattan and cane furniture. In India bamboo before being used was frequently soaked in Rangoon oil to protect them against these borers.

Dinoderus australiensis, Lesne.

Notes, Leydon Museum, vol. XIX, p. 184.
Ann. Soc. Ent. France, vol. LXVI, p. 328, 1897.

Described from specimens collected at Port Darwin, Northern Australia.

Dinoderus japonicus, Lesne.

Ann. Soc. Ent. France, vol. LXVI, p. 326, 1897.

This little beetle measures one-tenth of an inch. The prothorax is large, black, rounded, and very finely roughened in front, with rounded bands of fine spines. The wing covers rounded, clouded, with reddish brown at the base, very finely punctured, clothed with short scattered hairs, thickest on the apical portion.

I have specimens from Clark taken in bamboo imported to West Australia from Japan, and others collected at Port Darwin, North Australia, by Hill, in bamboo furniture. I have specimens bred from bamboo in the Technological Museum, Sydney, from Welch.

Dinoderus minutus, Fab.

Syst. Ent., p. 54; 1775.
Lesne, Ann. Soc., Ent. France, vol. LXVI, p. 329, 1897.
substriutus, Stephens, Ill. Brit. Entom., p. 352, 1830.
siculus, Bondi, Berl Ent. Zeitschr, 17, p. 336, 1873.
bifoveolatus, Woll. Ann. and Mag. Nat. Hist., vol. III, p. 409, 1850.

This species is about the same size as *Dinoderus japonicus,* similar in colouration, but the sides of the lurid portion of the prothorax are very finely punctured, and the striations and punctured on the wing covers not so well defined.

My specimens come from Sumatra.

Genus BOSTRYCHOPSIS, Lesne.

Bostrychopsis jesuita, Fabr.

Bostrychus jesuita, Ent. Syst., 1-2, p. 361.
Bostrychus jesuita, Bois duval, voy-d'-Astrolobe, vol. 11, p. 461.
Bostrychus jesuita, Macleay, Trans. Ent, Soc., N.S.W., p. 277, 1873.
Bostrychopsis jesuita, Lesne, Ann. Soc. Ent., France, p. 524, 1891.

Bostrychopsis jesuita, Froggatt, *Agr. Gaz.,* N.S.W., vol. xvii, p. 801; Australian Insects, p. 171, f. 77, 1907; Forest Insects of Australia, p. 140, 1923.

Bostrychopsis jesuita, French, Destruction Insects of Victoria, pt. iv, p. 88, 1900.

This is the largest bostrychid beetle in Australia, and is popularly called the "Auger beetle" on account of the clean-cut hole it makes, when cutting its way into the dying wood. Somewhat variable in size, it measures from ¾ inch to ½ inch, though the average is between the two. General colour, shining black, with reddish-brown antennæ, reddish pubescence round the head, and under surface of the abdomenal segments. Head large, turned down, and finely striated on the sides. Prothorax broadly rounded with the front portion covered with small spines and roughened plates, a row of spines down each side, the first projecting beyond the margin above the eyes, forming a recurved hook; the hind portion of prothorax finely shagreened. The body long, wing covers very coarsely and deeply punctured in regular parallel rows; the apex rounded, flattened in the centre with the tips irregularly striated with a small round projection on each side.

The natural food plants are wattles and eucalypts, but it is an omnivorus feeder, attacking other native trees, and also introduced cultivated shade and orchard trees. Olliff recorded it from Broken Hill (N.S.W.), investing pepper trees and white cedar. I have taken it in orange trees near Sydney, and in White Cedar, *Acacia pycantha,* and "Redwood" (*Cadellia pentastylis*), near Narrabri (N.S.W.). French bred it from the stems of fig, apple and orange trees, in Doncaster and Mildura, Victoria. Hill collected specimens at Roper's Creek and Port Darwin (N.T.). It was collected at Mount Murchison (W.A.) during the Elder Exploring Expedition. There are specimens in the Queensland Museum from Brisbane, Emerald, Winton, and Cairns. In all cases it attacks unhealthy dead or dying trees.

Genus RHIZOPERTHA, Stephens.

Rhizopertha domenica, Fabr.

Ent. Syst., 1 and 2, p. 359, 1792, and Supp. Ent. Syst., 1798.

Stephens, Ill. British Entomology, p. 354, 1830.

rufa, Hope, Trans. Ent. Soc., London, iv., p. 16, 1845, Waterhouse, Ann. and Mag., Nat. Hist., p. 349, 1888.

picea, Mursham, Ent. Brit., p. 88, 1802.

Lesne, Ann. Soc. Ent., France, vol. xxxvi, p. 477, 1911.

This is a remarkable member of the wood borers, because though it originally lived in the wood, it discovered that the contents of the containers were better food than the wood and became omnivorous, attacking all kinds of dried foodstuffs.

Its economic importance, therefore, is not as a wood-borer, but a destroyer of such material, particularly wheat and stored grain. Originally a native of India, carried in infested foodstuffs, it has spread all over the world, and in 1917 I recorded it swarming in the wheat stacks near Sydney, where it was gnawing up the wheat grains. An account of this beetle with text block is published in the *Agricultural Gazette of New South Wales,* p. 726, 1918. This beetle measures about ⅛ inch, and varies in tint from reddish-brown to black. The head is clothed with fine brownish hairs; the antennæ with the last three segments large and rounded. The prothorax covered with stout spines on the front margin with the hind portion punctured; clothed with fine hairs. Wing covers distinctly marked with fine punctures running in parallel rows and ornamented with rows of fine short bristle-like hairs.

Genus HETEROBOSTRYCHUS, Lesne.

Heterobostrychus aequalis, Waterhouse.

Proc. Zool. Soc., Lond., p. 215, p. 16, f. 3 (2), 1884.

Lesne, Ann. Soc. Ent., France, vol. xvii, p. 560, figs. 173-74, 1898.

uncipennis, Lesne, l.c., p. 173, 1895.

A rather slender cylindrical black beetle measuring two-fifths of an inch. The head is large with yellow antennæ, and a tuft of reddish yellow hairs round the jaws. The prothorax depressed in the front fringed, with stout spines on either side, the first projecting beyond the margin, finely punctured on the sides, and granulated on the hind margin. Legs smooth, dark-reddish brown. Wing-covers shining finely striated with somewhat irregular rows of distinct punctures; the tips rounded, slightly depressed in the centre, with a well-defined recurved spine on the summit on either side, with a smaller blunt spine below, the extreme tips slightly turned up. In the female there are no spines on the tips of the wing covers.

This species has a wide range over the East. It is recorded from India, China, Timor, Aru, New Caledonia, and the Philippines.

I have collected a large series of both larvæ and adult beetles, burrowing in the sapwood of Red Lauan timber from the Philippines at the Sydney wharves in February and March, 1925. There are specimens in the Australian Museum from Merauke, Dutch New Guinea.

I have examined the type (in the Australian Museum) of *Rhizopertha papuensis,* described by Macleay from the Fly River, New Guinea, which Lesne has suggested is identical with this species, but though it belongs to the same genus, it is a female of some other probably undescribed species.

Genus XYLODELEIS, Lesne.

Xylodeleis obispa, Germar.

Xylodeleis obispa, Linn, Ent. III, p. 222.

Xylodeleis obispa, Lesne, Ann. Soc. Ent., France, p. 525, f. 40, 1891.

Xylodeleis obispa, Lea, Pro. Linn. Soc., N.S.W., p. 92, 1904.

Xylopertha rufescens, Murray, Ann. and Mag., Nat. Hist., vol. xx, p. 94, 1878.

Apate serrata, Lea, Pro. Linn. Soc., N.S.W., vol. viii, p. 317, 1893.

Apate subcosta, Lea, Pro. Linn. Soc., N.S.W., vol. viii, p. 317, 1893.

Apate retusa, Lea, Pro. Linn. Soc., N.S.W., vol. viii, p. 320, 1893.

This is a very variable species both in size and form of the tips of the wing covers, but with a large series the main characteristics are fairly well defined. The largest measure up to ¼ inch, the smallest ⅛ inch. The general colour is dark-reddish brown to black, with the under-surface and legs reddish-brown. Head reddish, brown eyes, and mouth parts black, antennæ yellow. Prothorax large, somewhat truncate in front, which is very rugose, with small spines on the sides; dorsal surface and sides smooth and shining. Wing covers finely and closely punctured without distinctive parallel striæ. Extremities sharply truncated, forming a disk, more coarsely punctured than the wing covers. The junction of the wing covers forming a ridge down the centre, and the tips produced into a variable turned-up tail.

This beetle in the summer months is very plentiful in logs of the Spotted gum (*Eucalyptus maculata*) all down the South Coast, but it does not confine its attention to one species of gum. I have taken it from stringybark (*Eucalyptus macrorrhyncha*) logs at Uralla, and have found it burrowing in the dying stems of the Golden wattle (*Acacia pycnantha*), growing in a plantation near Narrabri. Lea has recorded it from Gosford and Tamworth (N.S.W.). Clark has sent me specimens from South and Western Australia, Lea and French record it from Tasmania and Victoria. Kershaw has specimens in the National Museum collections from Flora River, Northern Australia. In the Queensland Museum there are specimens from Brisbane, Wyreema, Bowen, Rockhampton, Port Denison, Cooktown, and Toowoomba.

Genus XYLODECTES, Lesne.

Xylodectes venustus, Lesne.

Ann. Soc. Ent., France, p. 540, 1891.

The author describes the type from Queensland.

Genus XYLOTILLUS, Lesne.

Only one species is recorded from Australia.

Xylotillus lindi, Blackburn.

Apate lindi, Blackb., Pro. Linn. Soc., N.S.W., p. 1263, 1890.

Xylotillus lindi, Lesne, Ann. Soc. Ent. France, p. 541, figs. 340-41, 1891.

Xylotillus lindi, Lea, Pro. Linn. Soc., N.S.W., p. 92, 1904.

This very distinctive little borer can be easily identified by the tails on the tips of the wing covers forming a pair of open calipers in both sexes; they vary much in size. I collected numbers burrowing vertical shafts just beneath the dry bark on felled logs of Mountain gum (*Eucalyptus dalrympleana*) in November, at Batlow

(N.S.W.). Blackburn says his type was cut out of burrows in a live *Eucalyptus* growing at Port Lincoln (S.A.).

Victoria: Specimens in National Museum, Melbourne. Bred out of a Eucalyptus branch used in a case of stuffed opossums.

Mackay, Queensland: Queensland Museum collections.

South Australia (Lea and Blackburn), Adelaide, and Port Lincoln.

New South Wales: Tamworth (Lea), Grenfell (Horace Brown).

Genus Xylion, Lesne.

Three species are listed on this genus, two of which have a wide range, and the third is described from northern New South Wales.

Xylion cylindricus, Macleay.

Bostrychus cylindricus, Macl., Trans. Ent. Soc., N.S.W., vol. 11, p. 277, 1873.
Froggatt, *Agricultural Gazette,* N.S.W., p. 414, fig. 3, 1903.
Australian Insects, 1907, p. 171, fig. 78.
Xylion cylindricus, Lesne, Ann. Soc. Ent., France, p. 557, fig. 371, 1891.
Xylion cylindricus, Lea, Pro. Linn Soc., N.S.W., p. 92, 1904.

This is the largest of the shot-hole borers which attack the freshly felled or drying hardwood logs all along the coastal districts and even far inland. It measures about one-third of an inch, and has the tips of the wing covers deeply scalloped with a blunt spine above on either side. I have cut it out of Spotted gum (*Eucalyptus maculata*) at Moruya, Gosford, and other localities along the New South Wales coast. Near Hay, Murrumbidgee River, I found them boring into a fallen Red gum (*Eucalyptus rostrata*). At Dorrigo, they attack the Coastal Blue Gum (*Eucalyptus saligna*). At Uralla they were found in dry logs of stringybark (*Eucalyptus macrorrhyncha*), I have had them boring in cultivated fig trees, and recorded them damaging wine casks in a wine cellar near Sydney. The type came from Gayndah, Queensland. There are specimens from Mount Tambourina, Brisbane, Charters Towers, West Burleigh, and Chinchilla, in the Queensland Museum. Lea records it from South Australia and Tasmania.

Xylion collaris, Erichson.

Apate collaris, Erich., Wiegan, Arch. for Naturg, vol. viii, p. 148, 1842.
Apate collaris, Froggatt, Pro. Linn. Soc., N.S.W., vol. ix, p. 123, 1894.
Xylion collaris, Lesne, Ann. Soc. Ent., France, p. 559, fig. 343, 1891.
Apate excavata, Lea, Pro. Linn. Soc. N.S.W., vol. viii, p. 318, 1893.
Apate bicolor, Lea, Pro. Linn Soc., N.S.W., vol. viii, p. 319, 1893.

This beetle is variable in size, measuring from two to three-tenths of an inch. It is easily recognised on having the prothorax reddish yellow, and the wing covers shining black. The extremities of the wing covers are truncate, forming a sloping disc, that of the male ornamented with four spines on the upper edge, and the tips curiously toothed, that of the female with the upper spines, but the tips regularly rounded.

In working out the life histories of Australian Coleoptera I recorded the activities of this beetle in several eucalypts in the vicinity of Sydney. Since taking up the study of forest entomology I have found it has a wide range, and identified its host plants. South Coast, N.S.W., common in bark and sapwood of the Spotted gum (*Eucalyptus maculata*), Dorrigo Forest in Blue Gum (*E. saligna*).

Lea has recorded it from Hobart (Tasmania) and Port Lincoln (S.A.). In the collection of the National Museum, Melbourne, there are specimens from Victoria, and one, doubtfully, from North Australia. In the Queensland Museum it is represented from Brisbane and Yandilla.

Xylion peramatus, Lesne.

Ann. Soc. Ent., France, p. 562, fig. 385-8, 1891.

This species was described from specimens collected at the Clarence River, New South Wales.

Genus Calophorus, Lesne.

Calophorus coriaceus, Lesne.

Ann. Soc. Ent., France, p. 405, figs. 8-9, 1891.

This species comes from Western Australia. Collected by De Bouley.

Genus Xylobosca, Lesne.

Xylobosca bispinosa, Macleay.

Bostrychus bispinosis, Macl., Trans. Ent. Soc., N.S.W. Vol. ii, p. 276, 1872.
Xylobosca bispinosa, Lesne, Ann. Soc. France, p. 568, figs. 395-7, 1891.
Xylobosca bispinosa, Lea, Pro. Linn. Soc., N.S.W., p. 474, 1911.
Xylobosca canina, Blackb., Trans. Roy. Soc. S.A. Vol. xvii, p. 131, 1893.
Rhizopertha elongatula, Macl. Trans. Ent. Soc. N.S.W. Vol. ii, p. 276, 1872.
Rhizophertha leai, Lesne, Ann. Soc. Ent. France, p. 564, figs. 391-2, 1891, p. 570, figs. 399-403.

In this species there is a very marked difference in the sexes. The short, thick-set male is dark reddish brown, measuring slightly over one-tenth of an inch. The prothorax short and broad, about twice the length of the body. The wing covers turned sharply down at the tips, forming a rounded boss with a pair of short angular spines in the centre in contact at the base, open in the centre. The female about the same length, but slender, with a longer head, and slightly curved prothorax, the hind portion smooth and shining; the wing covers long and finely granulated, rounded at the tips. With a pair of very tiny spines in the centre.

This type specimen was described from Gayndah (Q.). Lea gives an interesting account of this beetle, which he collected in numbers infesting a cultivated fig in a garden near Sydney. Last year (1925) I found this species with several others boring into the small stems of a dying Golden wattle (*Acacia pycnantha*), growing in a forest plantation near Narrabri (N.S.W.), and in the same district bred others out of the dried stems of a redwood (*Cadellia pentastylis*). I also cut them out of a stringybark log at a sawmill near Uralla (N.S.W.).

In the National Museum collection, Melbourne, there are specimens from Tasmania and King's Island. Lea records it from Lucindale (S.A.) and Queensland. Clark sent specimens from Geraldton (W.A.), and J. J. Walker collected specimens at the Adelaide River (Northern Australia) and Cape York (Queensland).

Xylobosca captiosa, Lesne.

Ann. Soc. Ent., France, p. 417, figs. 19-20, 1891.

Type specimen from Western Australia. Collected by De Bouley.

Xylobosca gemina, Lesne.

Ann. Soc. Ent. France, p. 569, fig. 398, 1891.

Type specimen from Cooktown (N.Q.). Collected by Meek.

Xylobosca hirticollis, Blackburn.

Xylopertha hiriticollis, Blkb., Trans. Royal Soc. S.A., p. 92, 1897.
Xylobosca hirticollis, Lesne, Ann. Soc. Ent., France, p. 572, figs. 400-6, 1891.

Type specimen from Roebuck Bay (W.A.).

Xylobosca mystica, Blackburn.

Xylopertha mystica, Blkb.
Xylobosca mystica, Lesne, Ann. Soc. Ent., France, p. 514, 1891.

A very small reddish-brown beetle under one-tenth of an inch, the tips of the wing covers sharply truncate. Prothorax rugose, wing covers finely punctured. I have a specimen identified as this species from Western Australia. The type specimen came from Petersburg (S.A.), where Blackburn cut them out of a live tree.

Xylobosca spinifrons, Lesne.

Ann. Soc. Ent., France, p. 415, fig. 11, 1891.

Described from specimens in the collection, Godefroy Nat. History Museum, Hamburg, from Peak Downs (Q.).

Xylobosca vicaria, Lesne.

Ann. Soc. Ent., France, p. 418, figs. 21-22, 1891.

Australia (no exact locality).

Genus Xylothrips, Lesne.

Xylothrips flavipes, Illiger.

Bostrychus flavipes, Ill., Mag. fur. Inskt. Hefl., 1-11, p. 179, 1891.
Xylothrips flavipes, Lesne, Ann. Soc. Ent., France, p. 256, 1891.

Xylothrips flavipes, Lesne, Bull. Soc. Ent., France, p. clxxviii, 1895.
Bostrychus dominicanus, Fab., Syst. Eluth. Vol. ii, p. 380, 1801.
Bostrychus sinuatus, Steph. Illustrations of British Entomology, 1830.
Bostrychus religiosus, Fairm. Rev. Mag. de Zool., p. 50, 1850.
Bostrychus mutilatus, Walk. Anns. and Mag., Nat. Hist., p. 286.
Bostrychus mutilatus, C. O. Waterh., Anns. and Mag., Nat. Hist., p. 343.
Bostrychus iracundus, Snellen von. Vollenh. Insects of Madagascar, pt. 5., p. 10, pl. 1, f. 7.

Though not a native of Australia, it is very common in the seasoned sapwood of Pacific maple (*Shorea* sp.), a timber which is imported in large quantities from the Philippine Islands, so that this beetle could be very easily introduced into Australia. It has a wide range over the East, and is recorded from India, China, the Malay Archipelago, and Philippines.

It is of a uniform bright reddish brown colour, with lighter coloured legs, and measures about ¼ of an inch. The front of the prothorax is covered with stout blunt spines, the lower ones curved upward, with the back and sides smooth and shining. The wing covers finely punctured, with the apex truncated with three raised points on either side and the tips forming a flattened process.

Xylothrips religiosus, Boisduval.

Bostrychus religiosus, Boisd. Voyage de l'Astrolabe. Vol. ii. p. 460, 1835.
Xylothrips religiosus, Lesne, Ann. Soc. Ent., France, p. 624, figs. 475-7, 1891.
Xylothrips religiosus, Lesne, Bull. Ent. Soc., France, p. clxxviii, 1895.
Bostrychus destructor, Montrouzier, Ann. Soc. d'Agri, Lyons. Vol. vii, p. 35, 1855.
Bostrychus destructor, Montez., Essai la fauna, Woodlark Island, 1857.
Bostrychus lifuanus, Montez. Ann. Soc. Ent., France, p. 267, 1861.
Bostrychus lifuanus, C. O. Waterhouse, Ann. and Mag., Nat. Hist., p. 350, 1888.

This is a dark reddish brown beetle, measures about ¼ inch. The prothorax finely rugose, with no very large spines in front. The wing covers very finely and closely punctured, those on the sides confluent, and forming wavy lines, the tips rounded with a slight depression in the centre, two very small projections on each side, and the extremites turning outward.

This beetle has a wide range over the Pacific Islands. It is recorded from Hawaii, Marquesas Islands, Samoa, New Caledonia, Tahiti, and the Solomon Islands. There are specimens from New Guinea in the Australian Museum. It has been collected in the Malay Peninsula, and introduced with foreign timber into England and Natal.

Specimens collected by Hill at Port Darwin (N.T.) have been identified by Lea as this beetle, who has also recorded it from Mackay (Q.) and Geraldtown (W.A.).

Genus XYLOSOCUS, Lesne.

Xylosocus capucinus, Fabricius.

Bostrychus capucinus, Fabr., Spec. Ins. Vol. i, p. 62, 1781.
Xylosocus capucinus, Lesne, Ann. Soc. Ent., France, p. 631, 1891.
Bostrychus eremiti, Oliv. Enc. Meth. Ins. Vol. v, p. 110, pl. 11, fig. 11, 1790.
Bostrychus marginatas, Fabr., Syst. El. Vol. ii, p. 382, 1801.
Bostrychus nicobaricus, Redenbacher, Reise Novara, Band. 2, p. 114, 1868.

This is a small black beetle with light coloured legs, in immature specimens the head and thorax are black, with the wing covers (except the tips) reddish brown. Length one-sixth of an inch. The front of the prothorax covered with stout spines, the rest very finely rugose. The wing covers very finely punctured, without paralle striae, forming a fine wavy pattern; the apex of the wing covers sharply truncated very finely, but distinctly punctured, the junction of the wing covers forming a ridge down the centre. My specimens come from Sumatra.

According to Lesne, it has been recorded from the Malay States, India, Tonkin, Madagascar, Ceylon, Reunion, Seychelles Islands, Sierra Leone, and the New Hebrides.

Xylosocus gibbicollis, Macleay.

Rhyzopertha gibbicollis, Macl., Trans. Ent. Soc., N.S.W. Vol. ii, p. 276, 1871.

Xylosocus gibbicollis, Lesne Ann. Soc. Ent., France, p. 627, fig. 479, 1891, and p. 638, fig. 488.

Xylosocus gibbicollis, Lea, Pro. Linn. Soc., N.S.W., p. 92, 1904.

Xylosocus gibbicollis, Lea, Pro. Linn. Soc., N.S.W., p. 323, 1893.

Xylopertha vidua, Blackb., Pro. Linn. Soc., N.S.W. Vol. iv, p. 1265, 1889.

Xylopertha vidua, Blackb., Trans. Roy. Soc. S. Aust. Vol. xvi, p. 39. 1892.

This is a small thick-set borer measuring about ⅛ of an inch, sharply truncate, and broadest at the apex of the wing covers. The head, thorax, and body black; antennæ and legs yellow, wing covers reddish brown, apex darkest. The prothorax having the front portion covered with fine black spines, hind portion smooth; wing covers very finely granulated, apex very finely and closely punctured.

It was originally described by Macleay from Gayndah (Q.). In the Queensland Museum there are specimens from Brisbane, National Park, Mount Tambourine, and Cooktown. Blackburn collected it at Port Lincoln (S.A.). It was collected in Central Australia by the Elder Exploring Expedition. Lea records it from Tasmania, and collected it at Tamworth and Tweed River (N.S.W.). I have bred it from stems of the South Australian Golden wattle (*Acacia pycnantha*) on several occasions, in the vicinity of Sydney. Clark sent me specimens from Perth (W.A.), and Lesne records it from New Caledonia.

This is the species figured in the *Agricultural Gazette of N.S.W.*, 1917, p. 814, which was found perforating the lead sheathing used to protect the overhead telephone wires in Sydney.

Xylosocus castanoptera, Fairm.

Bostrychus castanoptera, Fairm, Rev. de Zool. Vol. ii, p. 50, 1850.

Xylosocus castanoptera, Lesne, Ann. Soc. Ent., France, p. 635, 1891.

Xylosocus affinus, Branesik, Jahrl. des. Naturis, Ver. des Trenesin Comit, xv, p. 235, 1893.

This species, according to Lesne, has been recorded from Madagascar, Africa, Annam, Borneo, New Guinea, Tahiti, and Australia.

Genus SINOXYLON, Lesne.

Sinoxylon anale, Lesne.

Sinoxylon anale, Lesne, Ann Soc. Ent., France, p. 21, 1897.

Sinoxylon anale, Stebbing, Forest Insects of India No. 1, 1902.

Sinoxylon germinatum, Schilsky, Kaf. Env. Vol. xxxvi, p. 80, 1899.

Sinoxylon Apatodes macleayi, Blackb., Pro. Linn Soc., N.S.W. Vol. iii, p. 1429, 1888.

This handsome little beetle is under ¼ of an inch in length, short and broad in proportion, the body not twice the length of the prothorax. It varies in colour from black to reddish brown, in mature specimens they are nearly black with a bright reddish blotch on the sides of the basal portion of the wing covers. The head is rather small, with prominent round eyes and reddish brown palmate antennæ, the apical joints produced into three flattened plates which are expanded when the beetle is moving about. The prothorax is broad, rounded in front and covered with fine spines, rugose and sloping down on the hind margin. The wing covers finely and closely punctured sharply truncate at the tips, which are ornamented with a stout cylindrical spine in the centre on either side of the dorsal division.

This beetle is a native of the East, but has become established in Northern Australia, probably introduced in timber. Hill sent me specimens collected at Port Darwin (N.T.), and Blackburn described it from the same locality. I have obtained a number of live specimens in burrows in the sapwood of red lauan timber (*Shorea,* sp.) imported from the Philippines. Stebbing has recorded it as a pest in the same timber in India, and Schilsky described it from Northern China.

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